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ERRATA.

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Page 577, last line, *for* " x^2 " *read* " x^r ."

Page 578, line 9, *for* " γ " *read* " y ."

Page 579, line 18, *for* " $-.0189.5$ " *read* " $-.0189 \times s$."

Page 579, line 9 from bottom of page, *for* "1921 Census" *read*
"Registrar General's Annual Report, 1920."

JOURNAL OF THE ROYAL STATISTICAL SOCIETY.

JANUARY, 1926.

WHY DO WE SOMETIMES GET NONSENSE-CORRELATIONS BETWEEN
TIME-SERIES?—A STUDY IN SAMPLING AND THE NATURE OF
TIME-SERIES.

THE PRESIDENTIAL ADDRESS OF MR. G. UDN YULE, C.B.E., M.A., F.R.S.,
FOR THE SESSION 1925-26. DELIVERED TO THE ROYAL STATISTICAL
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THE problem which I have chosen as the subject of my Address is one that puzzled me for many years. The lines of solution only occurred to me two or three years ago, and I thought that I could not do better than endeavour to work them out during the Session 1924-25—time and opportunity having hitherto been lacking—and utilize them for the present purpose. As often happens, the country

to be explored opened up so widely as one advanced, that two or three years would have been a happier allowance of time for preparation than one year : much has had to be left aside for further exploration. But the results obtained up to the present stage seem to be of a good deal of interest and of some value.

First, let me expound with a little more detail and illustration the brief statement of the problem in my title.

SECTION I.—*The problem.*

It is fairly familiar knowledge that we sometimes obtain between quantities varying with the time (time-variables) quite high correlations to which we cannot attach any physical significance whatever, although under the ordinary test the correlation would be held to be certainly "significant." As the occurrence of such "nonsense-correlations" makes one mistrust the serious arguments that are sometimes put forward on the basis of correlations between time-series—my readers can supply their own examples—it is important to clear up the problem how they arise and in what special cases. Fig. 1 gives a very good illustration. The full line shows the proportion of Church of England marriages to all marriages for the years 1866–1911 inclusive : the small circles give the standardized mortality per 1,000 persons for the same years. Evidently there is a very high correlation between the two figures for the same year : the correlation coefficient actually works out at $+0.9512$.

Now I suppose it is possible, given a little ingenuity and goodwill, to rationalize very nearly anything. And I can imagine some enthusiast arguing that the fall in the proportion of Church of England marriages is simply due to the Spread of Scientific Thinking since 1866, and the fall in mortality is also clearly to be ascribed to the Progress of Science ; hence both variables are largely or mainly influenced by a common factor and consequently ought to be highly correlated. But most people would, I think, agree with me that the correlation is simply sheer nonsense ; that it has no meaning whatever ; that it is absurd to suppose that the two variables in question are in any sort of way, however indirect, causally related to one another.

And yet, if we apply the ordinary test of significance in the ordinary way, the result suggests that the correlation is certainly "significant"—that it lies far outside the probable limits of fluctuations of sampling. The standard error of a coefficient of correlation is $(1 - r^2)/\sqrt{n}$, where n is the number of observations : that is to say, if we have the values of the two variables x and y entered in their associated pairs on cards, if we take out at random a sample of n cards

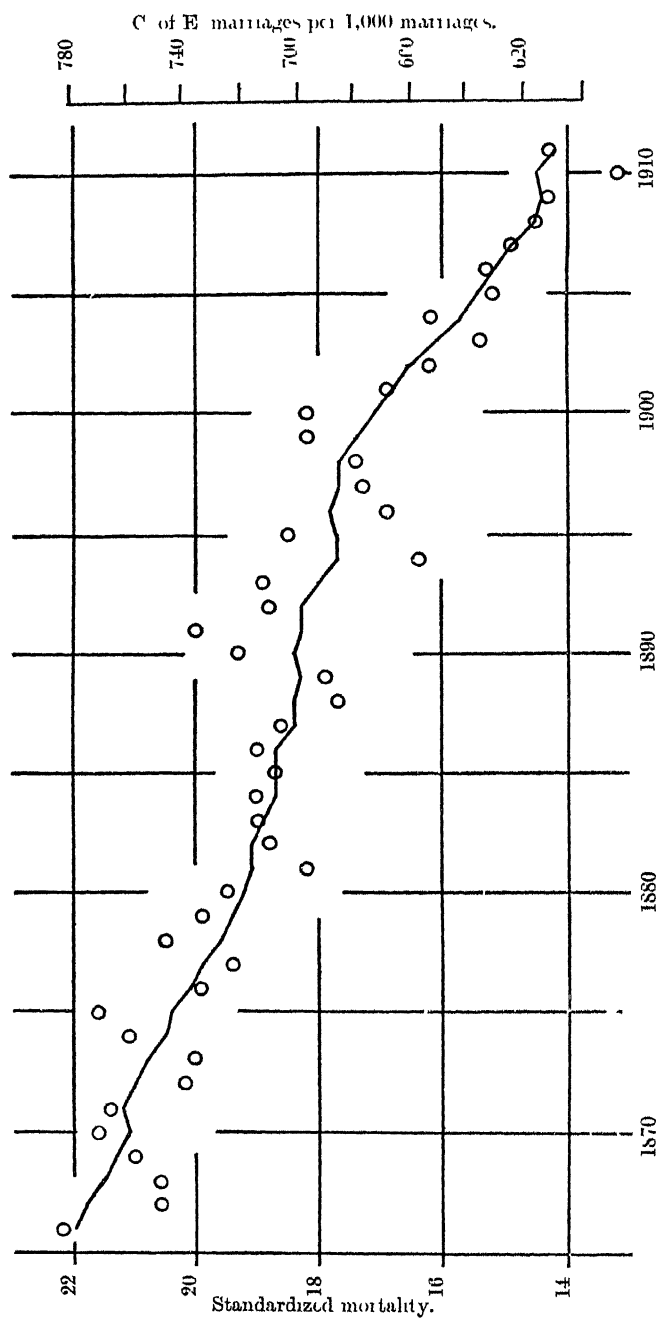


FIG. 1.—Correlation between standardized mortality per 1,000 persons in England and Wales (circles), and the proportion of Church of England marriages per 1,000 of all marriages (line), 1866-1911. $r = -0.9512$.

(small compared with the total of cards available) and we work out the correlation for this sample, take another sample in the same way, and so on—then the correlation coefficients for the samples will fluctuate round the correlation r for the aggregate of cards with a standard deviation $(1 - r^2)/\sqrt{n}$. For the assigned value of r , viz., 0.9512... and 46 observations, the standard error so calculated is only 0.0140, and on this basis we would judge that we could probably trust the coefficient within 2 or 3 units in the second place of decimals. But we might ask ourselves a different question, and one more germane perhaps to the present enquiry. If we took samples of 46 observations at random from a record in which the correlation for the entire aggregate was zero, would there be any appreciable chance of our getting such a correlation as 0.9512 merely by the chances of sampling? In this case the standard error would be $1/\sqrt{46}$, or 0.1474: the observed correlation is 6.45 times this, and the odds would be many millions to one against such a value occurring "by chance"—odds so great that the event may be written down as for all practical purposes impossible. On the ordinary test applied in the ordinary way we seem compelled to regard the correlation as having *some* meaning.

Now it has been said that to interpret such correlations as implying causation is to ignore the common influence of the time-factor. While there is a sense—a special and definite sense in which this may perhaps be said to cover the explanation, as will appear in the sequel, to my own mind the phrase has never been intellectually satisfying. I cannot regard time *per se* as a causal factor; and the words only suggest that there is some third quantity varying with the time to which the changes in both the observed variables are due—as in the argument of the imaginary rationalist above. But what one feels about such a correlation is, not that it must be interpreted in terms of some very indirect catena of causation, but that it has no meaning at all; that in non technical terms it is simply a fluke, and if we had or could have experience of the two variables over a very much longer period of time we would not find any appreciable correlation between them. But to argue like this is, in technical terms, to imply that the observed correlation is only a fluctuation of sampling, whatever the ordinary formula for the standard error may seem to imply: we are arguing that the result given by the ordinary formula is not merely wrong, but very badly wrong.

When we find that a theoretical formula applied to a particular case gives results which common sense judges to be incorrect, it is generally as well to examine the particular assumptions from which

it was deduced, and see which of them are inapplicable to the case in point. In obtaining the formula for the standard error we assume, to speak as before in terms of drawing cards from a record : (1) that we are drawing throughout from the same aggregate and not taking one sample from one aggregate, a second sample from another aggregate, and so on ; (2) that every card in each sample is also drawn from the same aggregate, in such a way that the 1st, 2nd, . . . n th cards in any sample are each equally likely to be drawn from any part of the aggregate, not the first card from one batch, the second from another, and so on ; (3) that the magnitude of x drawn on, say, the second card of the sample is quite independent of that on the first card, and so on for all other pairs in the sample ; and similarly for y ; there must be no tendency for a high value of x on the first card drawn to imply that the value of x on the second card will also probably be high ; (4) in order to reduce the formula to the very simple form given, we have also to make certain assumptions as to the form of the frequency-distribution in the correlation table for the aggregate from which the samples are taken.

In the particular case considered and in many similar cases there are two of these assumptions—leaving aside the fourth as comparatively a minor matter— which quite obviously do not apply, namely, the related assumptions (2) and (3). Our data necessarily refer to a *continuous* series of years, and the changes in both variables are, more or less, continuous. The proportion of marriages celebrated in the Established Church falls without a break for years together ; only a few plateaus and little peaks here and there interrupt the fall. The death-rate, it is true, shows much larger and more irregular fluctuations from year to year, but there is again a steady tendency to fall throughout the period ; only one rate (the last) in the first half of the years chosen, 1866-88, is below the average, only five in 1889-1911 are above it. Neither series, obviously, in the least resembles a random series as required by assumption (3).*

But can this breach of the assumed conditions render the usual formula so wholly inapplicable as it seems to be ? May it not merely imply, the reader may be inclined to question, some comparatively slight modification ? Even if the standard error by the usual formula were doubled, this would still leave the correlation

* The point that the usual formula for the standard error simply does not apply when we are dealing with correlations between time-series, has been made by Professor Persons ; (cf. his chapter on Time-Series in the *Handbook of Mathematical Statistics*, ed. by H. L. Rietz, p. 162. Cf. also Professor Scerist's remarks in the chapter on Time-Series of the new edition of his *Introduction to Statistical Methods* (1925), pp. 464-65.

almost certainly significant. The special case considered in the next section will suffice to show that when the successive x 's and y 's in a sample no longer form a random series, but a series in which successive terms are closely related to one another, the usual conceptions to which we are accustomed fail totally and entirely to apply.

SECTION II.—*The correlation between simultaneous segments of two variables that are simple harmonic functions of the time, of the same period but differing by a quarter-period in phase; and the frequency-distribution of correlations for random samples of such segments.*

To clarify our ideas, let us consider a case in which each of our variables is some simple mathematical function of the time. A very general form of function to take would be the polynomial

$$y = a + bt + ct^2 + dt^3 + \dots$$

But this is an inconvenient function for our present purpose, since it compels us to choose particular arbitrary values for the parameters a , b , c , etc.; nor is it a natural function to take as representing the changes in, say, some economic variable, over a long period of time, since y becomes infinite with t . A simple harmonic function of the time will be much better adapted to our purpose. Suppose, then, that the upper curve in Fig. 2 represents the changes in the first variable over some long period of time, say, many centuries—some period very much longer than any for which we are likely to

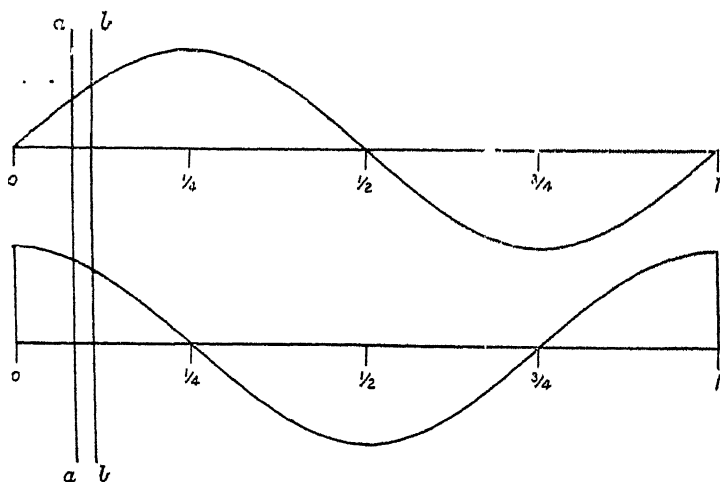


FIG. 2.—Two sine curves differing by a quarter-period in phase, and consequently uncorrelated when the correlation is taken over a whole period.

have statistics. Further, suppose that the lower curve, which is precisely similar to the first, except that it differs by a quarter-period in phase, represents the course of the second variable. Then it is evident that if we are given the two curves over a whole period, or any number of whole periods, the correlation between them is zero, for positive deviations in the one occur equally frequently with positive and with negative deviations in the other. But in actual fact, if the whole period 0 to 1 represents many centuries of time, our statistics will cover no more than some very short interval of the whole period, such as that enclosed between the two verticals *aa*, *bb*. This interval is so short that the segments of the two curves enclosed between *aa*, *bb*, are very nearly straight lines, the upper one rising, the lower one falling: the correlation between the corresponding observations will therefore be something very closely approaching -1 .

Suppose the interval to become infinitesimally short so that the segments of the two curves may be taken as strictly linear, and let us trace the changes in the correlation coefficient as the centre of the interval moves across the figure from left to right. If the centre of

the interval is placed at 0, the correlation must be zero, since the segment of the lower curve is horizontal and the values of the second variable are therefore the same for all values of the first. But as soon as the centre of the interval moves just to the right of 0, the segment of the upper curve is rising and that of the lower curve falling, so that the correlation becomes -1 . This value is maintained until the centre of the interval passes over the point $t = \frac{1}{4}$, when the correlation rises abruptly again to zero, as in Fig. 3. As soon

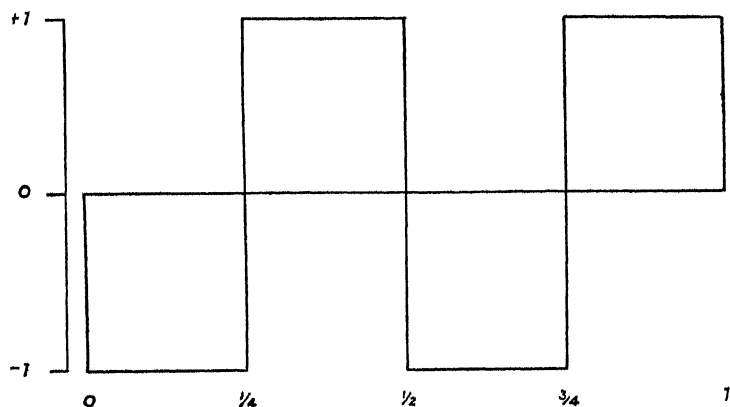


FIG. 3.—Variation of the correlation between two simultaneous infinitesimal elements of the harmonic curves of Fig. 2, as the centre of the element is moved across from left to right.

as the centre of the interval has passed this point the segments of both curves are falling, and the correlation is therefore < 1 . This value is maintained until the centre of the interval reaches the half-period, when the cycle repeats itself: Fig. 3 shows the complete course of affairs.

It is quite possible to imagine that our experience covers no more than a practically infinitesimal interval out of the whole period supposed, and the centre of that interval—the mid-point of our experience—will be equally likely to fall at any point between the times 0 and 1. If this is so, what will be the frequency-distribution of correlations for a series of such chance experiences? Evidently, from Fig. 3, $+1$ and -1 are the only values of the correlation that occur with finite frequency, and each of these values holds good over one-half of the entire range on which the centre of the interval may fall. Hence the frequency-distribution has burst outwards, as it were, into an ordinate at $+1$ and an equal ordinate at -1 : no intermediate values of r are possible.

If the interval over which we had experience, instead of being infinitesimal, covered just an entire period, the correlation would be zero: *i.e.*, the frequency-distribution of values of r on taking a series of random samples each of the length of a whole period would be simply an ordinate at zero. How, then, does the frequency-distribution for the first case pass into the frequency-distribution for the second case, as the length of the sample interval is gradually increased from something infinitesimally small up to the length of a period?

To solve this problem, it is first of all necessary to calculate curves like Fig. 3, showing, for any length of interval chosen, the values of r as the centre of the interval passes across the curves of Fig. 2 from left to right. As the curves are symmetrical, however, and repeat themselves, it is only necessary to carry out the calculations for one-eighth of the whole period. Fig. 4 shows such curves (the vertical scale being reversed as compared with Fig. 3 for convenience) when the interval is one-tenth, three-tenths, five-tenths, seven-tenths, and nine-tenths respectively of the period: the formulæ and method of calculation will be found in Appendix I. The first effect of lengthening the interval from something infinitesimally small up to 0.1 of a period is only slightly to round off the corners of the rectangles of Fig. 3, and quite slightly to decrease the maximum correlation attainable; it is not until the sample-interval becomes as large as half the period, or thereabouts, that the contours of the curve round off and the maximum undergoes a rather sudden drop. To obtain from any one of these curves the frequency-

distribution of values of r that would be given by placing the centre of the interval at random, it being equally likely to fall at any epoch in the whole period, we mark off along the base the abscissæ at which r attains, say, the values 0, 0.1, 0.2, 0.3, 0.4. . . .

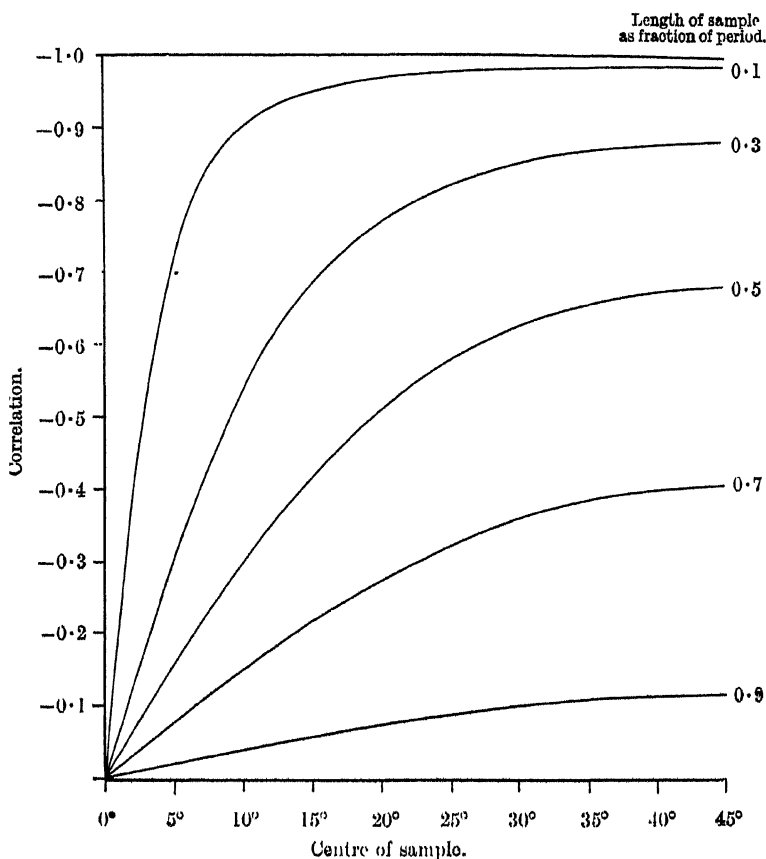


FIG. 4. Variation of the correlation between two simultaneous finite elements of the harmonic curves of Fig. 2, when the length of the element is 0.1, 0.3, . . . , 0.9 of the period, as the centre of the element is moved across from left to right; only one-eighth of the whole period shown.

If these points are t_0, t_1, t_2, t_3, t_4 , etc., the frequencies of correlations between the limits 0-0.1, 0.1-0.2, 0.2-0.3, 0.3-0.4, etc., are proportional to $t_1-t_0, t_2-t_1, t_3-t_2, t_4-t_3$, and so on. Graphic work would suffice to give a rough result, actually an algebraic interpolation formula was used (Appendix I). Inspection of the curves of Fig. 4

shows, however, what the form of the frequency-distributions must be, for evidently the steeper the curve in Fig. 4 the lower is the frequency. The maximum frequency must therefore always coincide with the maximum correlation attainable, where the curve is flat. Consequently all the curves must be U-shaped and, of course, symmetrical: the five distributions corresponding to the curves of Fig. 4 are shown in Figs. 5 to 9.

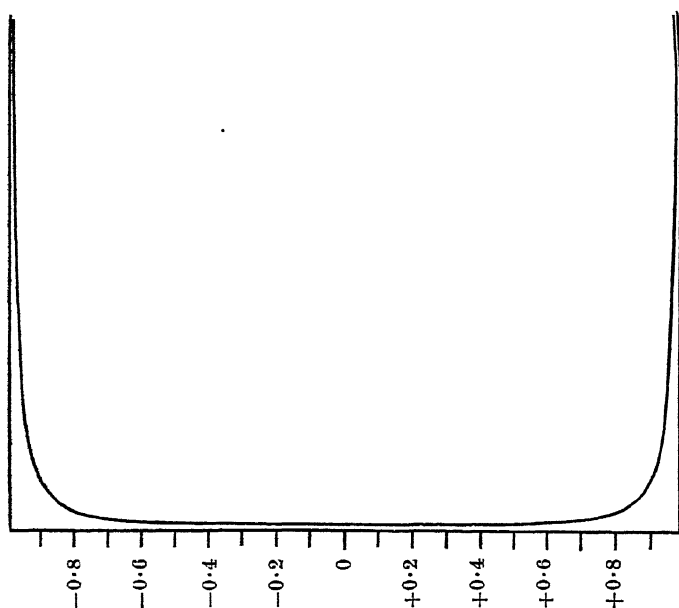


FIG. 5.—Frequency-distribution of correlations between simultaneous elements of the harmonic curves of Fig. 2, when the length of the element is 0.1 of the period. The following Figs. 6 to 9 show the change of form as the length of the element is increased from 0.1 to 0.9 by steps of 0.2.

The answer to our question, how the distribution of isolated frequencies at $+1$ and -1 closes up to the distribution of an isolated clump of frequency at zero, is then that the distribution first of all becomes a U-shaped distribution with limits not far from $+1$ and -1 , and that these limits, at first gradually and then more rapidly, close in on zero; but the distribution always remains U-shaped, and values of the correlation as far as possible removed from the true value (zero) always remain the most frequent.

The result is in complete contrast with what we expect in sampling under the conditions usually assumed, when the successive values of either variable drawn for the sample are independent of one

another. In that case the values of r in successive samples may differ widely, but the mode tends to coincide with the "true" value in the aggregate from which the sample is drawn—zero in the present illustration. Here the values in the samples tend to diverge

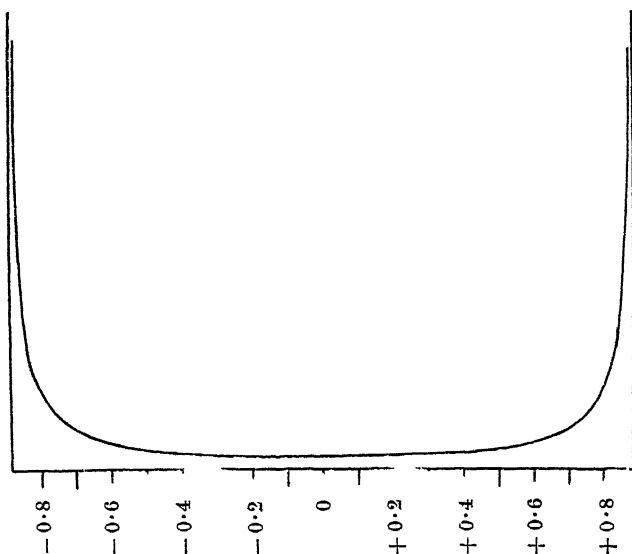


FIG. 6.—Cf. Fig. 5. Length of element, 0.3 of the period.

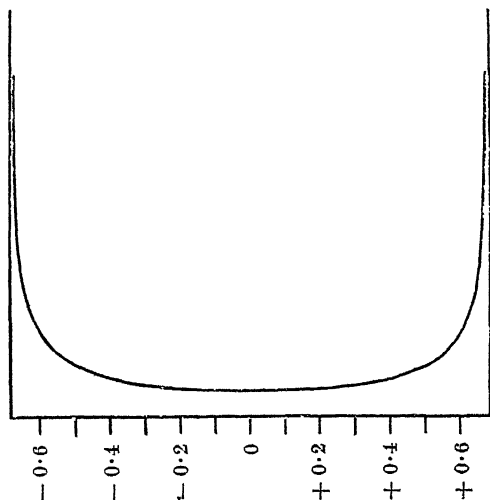


FIG. 7.—Cf. Fig. 5. Length of element, 0.5 of the period.

as widely as possible, in both directions, from the truth. We must evidently divest ourselves, in such a case, from all our preconceptions based on sampling under fundamentally different conditions. And evidently the result *suggests*—it cannot do more—the answer to the problem with which we started. We tend—it suggests—to get “nonsense-correlations” between time-series, in some cases, because some time-series are in some way analogous to the harmonic series that we have taken as illustration, and our available samples must be regarded as very small samples, if not practically infinitesimal, when compared with the length required to give the true correlation.

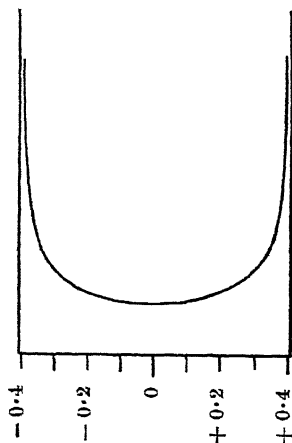


FIG. 8.—*Cf.* Fig. 5. Length of element, 0.7 of the period.



FIG. 9.—*Cf.* Fig. 5. Length of element, 0.9 of the period.

But what, it may be asked, is the frequency-distribution of values of r for small samples taken in the same way as for Figs. 5 to 9, if the correlation over a whole period is not zero? To answer this question by way of illustration I have taken two harmonic curves differing in phase by 60° , so that the correlation over a whole period is ± 0.5 , and have assumed the length of the samples to be one-fifth of the period. Fig. 10 shows the resulting frequency-distribution. It will be seen that it remains U-shaped, but has become asymmetrical. The limits are -0.85055 and $+0.98221$, and frequencies are much higher near the positive limit. Roundly

68 per cent. of the correlations are positive, 32 per cent. are negative, nearly 48 per cent. exceed $+0.9$, only some 13 per cent. are less than -0.8 . We could only conjecture, in such a case, that the true correlation was positive, if we had a number of samples available, and noted that those giving a positive correlation were to those giving a negative correlation as about 2 to 1. Quite often,

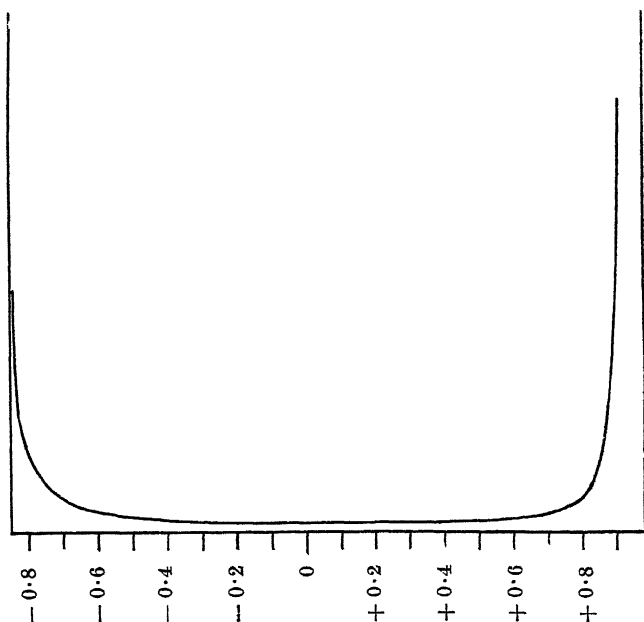


FIG. 10.—Frequency-distribution of correlations between two simultaneous elements of harmonic curves differing by 60° in phase (correlation over a whole period $+0.5$) when the length of element is 0.2 of the period.

at about one trial in eight, a single sample might entirely mislead us by giving a high negative correlation exceeding 0.8 . And, be it remembered, we have taken a fairly long sample, amounting to one-fifth of the period; if the complete period were something exceeding, say, 500 years, it is seldom that we would have such a sample at our disposal.

SECTION III.—*Deductions from Section II: classification of empirical series*

The work of Section II suggested that we tend, in some cases, to get meaningless correlations between time-series, because some time-series are in some way analogous to the harmonic series that

we took as illustration. The question has now to be answered, what is the precise analogy? What characteristics must two empirical series possess in order that small random samples, taken from them in the same way that we took the small samples from the sine-curves, may tend to give a U-shaped frequency-distribution for the resultant correlations?

The phenomenon is clearly related to the fact that a small segment of a sine-curve, taken at random, tends to be either *rising* or *falling*, not more or less level, and consequently tends to give high correlations of either sign with other segments taken at random. How can we secure such conditions in an empirical series? Will it suffice if, as in such series as might be represented by the curves of Fig. 2, successive terms of the series are highly correlated with one another? Thus, suppose the whole period in Fig. 2 is 360 years, so that one year corresponds to 1° . Then, if we take the product-sum over an entire period, the correlation between the value of the variable in one year and the value in the next is $\cos 1^\circ$, or 0.99985; between the value in one year and that in the next but one, $\cos 2^\circ$, or 0.99939, and so on (cf. Appendix I, equation 6), the correlations running

r_1	...	...	0.99985	r_6	...	...	0.99452
r_2	...	...	0.99939	r_7	...	...	0.99255
r_3	...	...	0.99863	r_8	...	...	0.99027
r_4	...	...	0.99756	r_9	...	...	0.98769
r_5	...	...	0.99169	r_{10}	...	...	0.98481

I propose to term such correlations, r_1 between u_s and u_{s+1} , r_2 between u_s and u_{s+2} , etc., where u_s is the value of the variable in year s , the *serial correlations* for the given series.

Now will it suffice to give us a U-shaped distribution of correlations for samples from two empirical series, if the serial correlations for both of them are high, and positive at least as far as r_{n-1} where n is the number of terms in the sample? This will imply that if the first term in a sample is considerably above the average of the sample, the next following terms will probably be above the average also, and some later terms must correspondingly be below the average to compensate for this excess: the graph of the sample will then tend to show a certain trend downwards from left to right. Conversely, if the first term is below average, the graph will tend to show an upward trend from left to right. Hence, generally, the graph of a random sample taken from such a series will tend to show not merely random fluctuations about a horizontal line, but a trend either upwards or downwards. The result must be that

if we take two such random samples, the correlation between them will tend to be markedly positive or markedly negative, according as the two trends are of the same or of opposite signs. This suggests that the frequency-distribution of correlations will be widely dispersed and possibly tend to be bimodal. But will it tend to the extreme of bimodality, a definite U-shape?

Is there not something more concealed in the assumption of a harmonic function for Fig. 2? When we take a small sample out of either of the curves, such as that between the verticals *aa*, *bb* of the figure, the sample does not tend to show a more or less *indefinite* upward or downward trend; it moves upward or downward with a clear unbroken sweep. This must imply something more: if the curve is going up from year *s* to year *s* + 1, it tends to rise further from year *s* + 1 to year *s* + 2, which is to say, that *first differences are positively correlated with each other*, as well as the values of the variable. For the sine-curve, in fact, we know that the first differences form a curve of the same period as the original: the serial correlations for the *first differences* are therefore precisely the same as those for the values of the variable, given above. This is a very important additional property. It suggests that, for random samples from two empirical series to give a U-shaped distribution of correlations, each series should not merely exhibit positive values for the serial correlations up to r_{n-1} , but their difference series should also give positive serial correlations up to the limit of the sample.

Let us now endeavour to make these ideas a little more definite. The usual theory of sampling is concerned only with the simplest case, the *random series*, for which the serial correlations are zero. If we take a number of samples of *n* observations out of such a series, it is familiar that the correlation between the deviations of any two observations *from the mean of the sample* is $-1/(n-1)$. If, then, the first term of the sample is above the mean of the sample, there is no definite tendency for the sample as a whole to show a downward trend, excluding the first term itself; for *all* the remaining terms have an *equal*, and that only a slight tendency to be below the average. Thus, I took the 60 sets of 10 random terms each, forming the experimental series A_0 to F_0 of the next section, worked out the deviation of every term in each sample from the mean of that sample, and then separated the samples into two groups: (*a*) those in which the first deviation was positive, (*b*) those in which the first deviation was negative. I found 28 of the former and 32 of the latter. Taking each group separately, I averaged separately the deviations of the 1st, 2nd . . . 10th terms. The standard deviations of all the terms being the same, and the

correlation of every term with every other being $-1/9$, if we call the mean of the positive deviations of the first term 1000, the most probable deviation of each of the others is $1000/9$ or 111, as in Table I, col. 2. The average of the series in which the first deviation was positive gave the result shown in col. 3: the figures run rather irregularly, as the fluctuations of sampling are large, but there is no consistent deviation from expectation and clearly no consistent trend in terms 2 to 10. The average of the series in which the first deviation was negative, reversing signs all through for readier comparability, gave the result shown in col. 4; and finally, combining the two sets by reversing sign in the totals of the series with first deviations negative and adding to the totals of the set with first deviations positive, we have the general average of col. 5. The figures of neither col. 3, nor col. 4, nor col. 5 show any definite trend in terms 2 to 10. Selection of the first term does not bias the remainder of the sample, or give it any trend or "tilt" either upwards or downwards; the remaining terms are still random in their order.

TABLE I.—Deviations from the mean of the sample in samples of 10 terms from a random series, averaging separately samples in which the first deviation is positive and samples in which the first deviation is negative: average of first deviations taken as + 1000.

Term.	Expectation.	Experimental results.		
		First term +.	First term -.	Together.
(1)	(2)	(3)	(4)	(5)
1	+ 1000	+ 1000	+ 1000	+ 1000
2 ..	- 111	- 155	- 113	132
3 .	- 111	- 470	- 25	206
4 .	- 111	- 15	- 105	63
5 .	- 111	- 452	- 136	284
6 ..	- 111	+ 300	+ 87	186
7	- 111	- 321	- 190	251
8	- 111	- 137	+ 171	27
9 ..	- 111	+ 449	- 389	2
10 ...	- 111	- 199	- 351	280

Now suppose we take from a series of random terms (with the mean zero) a sample of ten terms $a, b, c, d, e, f, g, h, k, l$, and form from it, by successive addition, a new series $a, a + b, a + b + c, \dots$. In this new series the terms are correlated with each other, since each term contains the term before, but the differences are random. Let us find the correlations between deviations of the terms from

the mean of the sample. For our special case of 10 terms the mean is

$$a - 0.9b - 0.8c + 0.7d + 0.6e + 0.5f + 0.4g + 0.3h - 0.2i + 0.1l.$$

The deviations of the successive terms from the mean are then as given in Table II. The standard deviation of each deviation in a

TABLE II.—Coefficients of the terms in the deviations from the mean of the sample, in a sample of 10 terms from a series with random differences $a, b, c \dots l$.

Term.	(1) <i>b</i>	(2) <i>c</i>	(3) <i>d</i>	(4) <i>e</i>	(5) <i>f</i>	(6) <i>g</i>	(7) <i>h</i>	(8) <i>i</i>	(9) <i>l</i>	Coefficient of s.d.
1	-0.9	-0.8	-0.7	-0.6	-0.5	-0.4	-0.3	-0.2	-0.1	1.688
2	+0.1	-0.8	-0.7	-0.6	-0.5	-0.4	-0.3	-0.2	-0.1	1.432
3	+0.1	+0.2	-0.7	-0.6	-0.5	-0.4	-0.3	-0.2	-0.1	1.204
4	+0.1	+0.2	+0.3	-0.6	-0.5	-0.4	-0.3	-0.2	-0.1	1.025
5	+0.1	+0.2	+0.3	+0.4	-0.5	-0.4	-0.3	-0.2	-0.1	0.922
6	+0.1	+0.2	+0.3	+0.4	+0.5	-0.4	-0.3	-0.2	-0.1	0.922
7	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	-0.3	-0.2	-0.1	1.025
8	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	-0.2	-0.1	1.204
9	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	-0.1	1.432
10	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	1.688

TABLE III.—Correlations between deviations from the mean of the sample, in a sample of 10 terms from a series with random differences.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	+1.	+0.81	+0.57	+0.26	-0.10	0.42	-0.61	-0.66	-0.64	-0.58
2	+0.81	+1.	+0.73	+0.37	-0.01	0.42	-0.65	-0.73	-0.71	-0.64
3	+0.57	+0.73	+1.	+0.61	+0.14	0.32	-0.61	-0.72	-0.73	-0.66
4	+0.26	+0.37	+0.61	+1.	+0.48	0.05	-0.43	-0.61	-0.65	-0.61
5	-0.10	0.04	+0.14	+0.48	+1.	+0.41	0.05	0.32	-0.42	-0.42
6	-0.42	-0.42	0.32	-0.05	+0.41	+1.	+0.48	+0.14	0.04	-0.10
7	0.61	0.65	0.61	-0.43	-0.05	+0.18	+1.	+0.61	+0.37	+0.26
8	0.66	0.73	0.72	0.61	0.32	-0.14	+0.61	+1.	+0.73	+0.57
9	0.64	-0.71	0.73	0.65	0.12	-0.01	+0.37	+0.73	+1.	+0.81
10	-0.58	-0.61	0.66	0.61	0.42	0.10	+0.26	+0.57	+0.81	+1.

series of such samples will be the square root of the sum of the squares of the numerical coefficients, multiplied by the standard deviation of the original random series $a, b, c \dots x$; it will be seen from the column on the right of Table II that the end terms are the most variable, the central terms the least variable, and the standard deviations are symmetrical about the centre of the sample. The product-sum for any pair of terms will be the sum of the products of corresponding numerical coefficients in the same column, multiplied by the square of the s.d. of the series $a, b, c \dots x$, and hence the correlation will be given by dividing the sum of

the products by the product of the s.d. coefficients on the right of Table II. The resulting coefficients of correlation are shown in Table III. It will be seen that for terms which are closely adjacent at either end of the sample they are fairly high and positive, but for terms at opposite ends moderately high and negative. Thus, taking the correlations of the first term with the others, the correlation between deviations 1 and 2 is $+0.81$, but between 1 and 3 drops to $+0.57$. Between 1 and 5 there is a small negative correlation, and this negative correlation reaches a maximum of -0.66 between deviations 1 and 8. The negative correlation then falls away slightly and is only -0.58 between the first and last deviations 1 and 10. Evidently the general effect of this arrangement of correlations must be, as already argued, to give the sample *as a whole a tendency* to be tilted one way or the other as the first term is above or below average. If the first term is, say, 1 unit above the mean of the sample, the mean deviations of the others will be given by their regressions on the first term, which can be found from the correlations and s.d.'s already given. Multiplied by 1000 these are shown in column 2 of Table IV, and it will be seen that they give a continuous descent from the $+1000$ of term 1 to -579 for term 10.

TABLE IV.—Deviations from the mean of the sample in samples of 10 terms from a series with random differences, averaging separately samples in which (a) first deviation is $+$, (b) first deviation is $-$, (c) last deviation is $+$, (d) last deviation is $-$. The average of first or last deviations, respectively, called $+1000$.

Term.	Expectation.	Experimental results a and b.	Term.	Experimental results.	
				c and d.	Together.
(1)	(2)	(3)	(4)	(5)	(6)
1	..... $+$ 1000	$+$ 1000	10	$+$ 1000	$+$ 1000
2	..... $+$ 684	$+$ 681	9	$+$ 636	$+$ 658
3	..... $+$ 404	$+$ 367	8	$+$ 398	$+$ 383
4	..... $+$ 158	$+$ 144	7	$+$ 169	$+$ 157
5	..... $-$ 53	$-$ 98	6	$-$ 56	$-$ 76
6	..... $-$ 228	$-$ 300	5	$-$ 217	$-$ 257
7	..... $-$ 368	$-$ 361	4	$-$ 459	$-$ 411
8	..... $-$ 474	$-$ 286	3	$-$ 516	$-$ 404
9	..... $-$ 544	$-$ 528	2	$-$ 545	$-$ 537
10	..... $-$ 579	$-$ 619	1	$-$ 411	$-$ 512

This result was again checked by experiment. From the experiments described in the next section of the paper 60 sets of 10 terms each were available from series with random differences

(series A_1 to F_1). The deviations of the terms in each sample from the mean of that sample were worked out, and the samples were then arranged in two groups as before according as the first deviation was positive or negative, and totalled. Reversing signs in the second set, and combining with the first as for the last column of Table I, and then dividing through by the total of the first term, the figures of column 3 of Table IV were obtained. It will be seen that the agreement with expectation is very fair: the correlations are not high and fluctuations of sampling are large. But a second test can be made. Since the correlations and s.d.'s are symmetrical, exactly the same result is to be expected if we re-sort the samples according as the *last* term is positive or negative, and then take ratios on the average of the *last* term. The work was done in the same way, and the results are given in column 5 of Table IV. Combining the data on which columns 3 and 5 were based, the ratios of column 6 were obtained. Columns 3, 5 and 6 are all in fair agreement with expectation, and show exactly the same thing. In marked contrast with the random series, the sample from the series with random differences shows a clear tendency to tilt one way or the other as a whole; and hence one random sample from such a series will tend to give more or less marked correlations, either positive or negative, with another. But it must be remembered that this *tendency* of the sample to be tilted one way or the other as a whole is only a tendency; it is sufficiently clearly marked to attract attention during experimental work, but by no means stringent, as is evident from the moderate values of the correlations in Table III.

We have now to consider the third type of series that has suggested itself, the series in which not merely successive terms, but also successive first differences, are positively correlated. The simplest way in which to construct such a series seems to be to sum the last series again, term by term, *i.e.*, to form the second sum of the random series instead of the first. Taking 10 terms only, the second sum will run—

$$\begin{aligned} & a \\ & 2a + b \\ & 3a + 2b + c \\ & 4a + 3b + 2c + d \end{aligned}$$

$10a + 9b + 8c + 7d + 6e + 5f + 4g + 3h + 2k + l,$
and the mean is—

$$\begin{aligned} & 5 \cdot 5a + 4 \cdot 5b + 3 \cdot 6c + 2 \cdot 8d + 2 \cdot 1e + 1 \cdot 5f + g \\ & \quad + 0 \cdot 6h + 0 \cdot 3k + 0 \cdot 1l. \end{aligned}$$

The deviations and coefficients of the s.d.'s of the several terms are then as shown in Table V, and Table VI gives the correlations calculated in the same way as before. It will be seen that the standard deviations are now no longer symmetrical about the centre of the sample, the s.d. of term 10 being much larger than that of term 1; while the general arrangement of the correlations is similar to that of Table III, the correlations are much higher, and again they are not symmetrical with respect to the two ends of the sample. But the magnitude of the correlations is now *very* high. Between terms 1 and 2 there is a correlation of 0.992, and between terms 9 and 10 a correlation of 0.991. The maximum negative correlation is that between terms 2 and 8 or 3 and 9, and is -0.988. The tendency of the sample to "tilt" as a whole becomes now very clearly marked, so clear that it becomes quite evident on forming even a few experimental samples in this way.

TABLE V.—Coefficients of the terms in the deviations from the mean of the sample, in a sample of 10 terms from a series of which the second differences are random.

Term.	(1) <i>a</i>	(2) <i>b</i>	(3) <i>c</i>	(4) <i>d</i>	(5) <i>e</i>	(6) <i>f</i>	(7) <i>g</i>	(8) <i>h</i>	(9) <i>k</i>	(10) <i>l</i>	Coefficient of s d.
1 ..	-4.5	-4.5	-3.6	-2.8	-2.1	-1.5	-1.0	-0.6	-0.3	-0.1	2.635
2....	-3.5	-3.5	-3.6	-2.8	-2.1	-1.5	-1.0	-0.6	-0.3	-0.1	2.311
3....	-2.5	-2.5	-2.6	-2.8	-2.1	-1.5	-1.0	-0.6	-0.3	-0.1	1.877
4 ..	-1.5	-1.5	-1.6	-1.8	-2.1	-1.5	-1.0	-0.6	-0.3	-0.1	1.357
5 ..	-0.5	-0.3	-0.6	-0.8	-1.1	-1.5	-1.0	-0.6	-0.3	-0.1	0.801
6 ..	+0.5	+0.5	+0.4	+0.2	-0.1	-0.5	-1.0	-0.6	-0.3	-0.1	0.492
7 ..	+1.5	+1.5	+1.4	+1.2	+0.9	+0.5	—	-0.6	-0.3	-0.1	0.971
8 ..	+2.5	+2.5	+2.4	+2.2	+1.9	+1.5	+1.0	+0.4	-0.3	-0.1	1.738
9 ..	+3.5	+3.5	+3.4	+3.2	+2.9	+2.5	+2.0	+1.4	+0.7	-0.1	2.597
10 ..	+4.5	+4.5	+4.4	+4.2	+3.9	+3.5	+3.0	+2.4	+1.7	+0.9	3.513

The experimental series with correlated differences were not as a fact formed in the way suggested, but the method used is equivalent in the present respect for samples of 10 observations (*cf.* Appendix II, under heading C, pp. 61-2). Of the 60 samples (series A₂ to F₂) only 6 gave first and last deviations of the same sign. The regressions obtained from Tables V and VI on the first term and the last respectively were used to obtain columns 2 and 5 of Table VII, and the experimental results are compared with these figures in columns 3 and 6 of the same table, which is analogous to Table IV. Given the first deviation, the last term should show a greater negative deviation, and in the experimental results it is greater, though not so much greater as it should be. Given the

TABLE VI.—Correlations between deviations from the mean of the sample, in a sample of 10 terms from a series of which the second differences are random.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	...	+ 1.	+ 0.992	+ 0.967	+ 0.907	+ 0.707	- 0.315	- 0.941	- 0.976	- 0.958
2	...	+ 0.992	+ 1.	+ 0.987	+ 0.938	+ 0.752	- 0.271	- 0.940	- 0.988	- 0.976
3	.	+ 0.967	+ 0.987	+ 1.	+ 0.974	+ 0.819	- 0.182	- 0.915	- 0.990	- 0.988
4	...	+ 0.907	+ 0.938	+ 0.974	+ 1.	+ 0.913	+ 0.012	- 0.841	- 0.962	- 0.981
5	...	+ 0.707	+ 0.752	+ 0.819	+ 0.913	+ 1.	+ 0.360	- 0.589	- 0.803	- 0.869
6		- 0.315	- 0.271	- 0.182	+ 0.012	+ 0.360	+ 1.	+ 0.507	+ 0.213	+ 0.072
7	...	- 0.941	- 0.940	- 0.915	- 0.841	- 0.589	+ 0.507	+ 1.	+ 0.938	+ 0.869
8	...	- 0.976	- 0.988	- 0.990	- 0.962	- 0.803	+ 0.213	+ 0.938	+ 1.	+ 0.982
9	...	- 0.958	- 0.976	- 0.988	- 0.981	- 0.869	+ 0.072	+ 0.869	+ 0.982	+ 1.
10	...	- 0.935	- 0.956	- 0.973	- 0.977	- 0.891	- 0.005	+ 0.819	+ 0.955	+ 0.991

last deviation, on the other hand, the negative deviation of the first term should be considerably less, and in the experiment it is less, but not so much less as it should be. But the broad agreement with theory is evident; fluctuations of sampling from series to series are large as before.

TABLE VII.—Deviations from the mean of the sample, in samples of 10 terms from a series of which the second differences are random, averaging separately samples in which (a) first deviation is +, (b) first deviation is —, (c) last deviation is +, (d) last deviation is —. The average of first or last deviations respectively called 1000.

Term.	Expectation.	Experimental result a and b.	Term.	Expectation.	Experimental result c and d.
(1)	(2)	(3)	(4)	(5)	(6)
1	.. + 1000	+ 1000	10	.... + 1000	+ 1000
2	.... + 870	+ 811	9	.... + 733	+ 763
3	.... + 689	+ 597	8	.... + 473	+ 528
4	.. + 467	+ 391	7	... + 226	+ 289
5	.... + 215	+ 144	6	.... — 1	+ 49
6	.... — 59	— 107	5	... — 203	— 173
7	.. — 347	— 360	4	.... — 377	— 376
8	.... — 644	— 607	3	.... — 520	— 542
9	.. — 945	— 829	2	.... — 629	— 697
10	.... — 1247	— 1040	1	.... — 702	— 841

Now this argument has led us to a remarkable result, which at first sight may seem paradoxical: namely, that for the present purpose we are really only concerned with the serial correlations for the *differences* of our given series, and not with the serial correlations of those series themselves. For if we take a long but finite series of random terms and sum it, the serial correlations for the sum-series are not determinate and will vary from one such series to another: and yet all such series evidently have the same characteristics from the present standpoint. And obviously again, if we form the second-sum of a long but finite series of random terms, the serial correlations for the second-sum are not determinate and will vary from one such series to another, and yet all such series, from the present standpoint, have the same characteristics. If in either case we make the series indefinitely long, all the serial correlations will tend towards unity, but the samples remain just the same as they were before, so evidently we cannot be concerned with the mere magnitude of the serial correlations themselves: they are dependent on the length of the series.

Let the serial correlations for the series itself be

$$1, r_1, r_2, r_3, r_4, \dots r_k,$$

and for the difference series

$$1, \rho_1, \rho_2, \rho_3, \rho_4, \dots \rho_k,$$

then it is shown in Appendix II that for a long series in which we may neglect the effect of the end-terms,

$$\rho_k = \frac{2r_k - r_{k+1} - r_{k-1}}{2(1-r_1)} = -\frac{1}{2(1-r_1)} \Delta^2(r_{k-1}).$$

If now we are given the ρ 's, all that we know is the *form* of the function

$$r_k = \phi(k).$$

If the ρ 's are all zero, or the sum-series is the sum of a random series, r_k is a linear function of k . If all that we know is that the ρ 's are positive, all that we can say about the r 's is that the graph of the r 's to k as abscissa must give a curve that is concave downwards. If more definitely we know that the ρ 's are a decreasing arithmetical series, the graph of the r 's is a cubic parabola. If the ρ 's form an oscillatory series, the graph of the r 's must exhibit oscillations (*cf.* Fig. 19, p. 43).

The serial correlations up to r_{10} were worked out for three series of 100 terms with random differences, and the results are shown graphically in Fig. 11: the data will be found in Appendix II, Table A. The series A_1 and C_1 give very fair fits to straight lines: B_1 is rather more erratic—but it must be remembered that all are rather short series. It will be noted from the figure how greatly the actual magnitudes of the serial correlations differ for the three series: in A_1 , r_{10} is +0.776; in B_1 , +0.242; in C_1 , +0.519.

The serial correlations were also worked out for three series of 100 terms in which the difference correlations were a descending arithmetic series, and these results are shown in Fig. 12, the data being given in Table B of Appendix II. In this case the observed correlations for all three series lie fairly closely round cubics of the required type. Note again how largely the actual values of the serial correlations differ from series to series. It is the *form* of the curve alone which determines the values of the difference correlations. The fact that the concavity faces downwards indicates at once to the eye that the sign of the difference correlations is positive, but the eye alone can hardly judge what function ρ_k is of k .

Statistical series may evidently be classified by the nature of the serial correlations, and such a classification will be important from

the standpoint of the present enquiry. I suggest the following classification and technical terms:—

Random series.—Series for which all the serial correlations, in an indefinitely long series, are zero.

Conjunct series.—Series for which all the serial correlations are positive. We can readily imagine ideal cases for which, in an

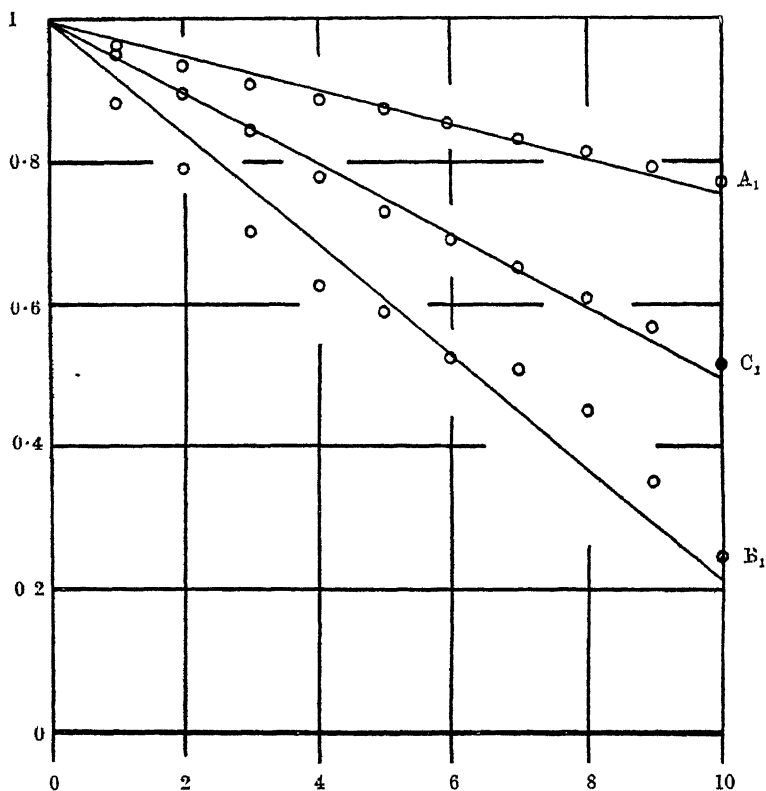


FIG. 11.—Serial correlations up to r_{10} for three experimental series (of 100 terms) with random differences.

indefinitely long series, r_k is positive for all values of k , but in a finite series r_k decreases with k and becomes negative. For practical specification we are only concerned with a finite number of serial correlations, and may speak of a series as “conjunct up to r_k .” If, for example, some statistical variable is strictly periodic with a period of 1,000 years, annual data concerning it form, properly speaking, a periodic series. But if we have data for no more than a

century or two we may only recognize it as a conjunct series, "conjunct up to r_{50} " or so.

Disjunct series.—Series for which the serial correlations are all negative. The ideal case is possible (*cf.* Appendix II, sub-head D, pp. 62–3), but the conditions of consistence imply stringent limitations on the values of the correlations. For the random series ρ_1 , for

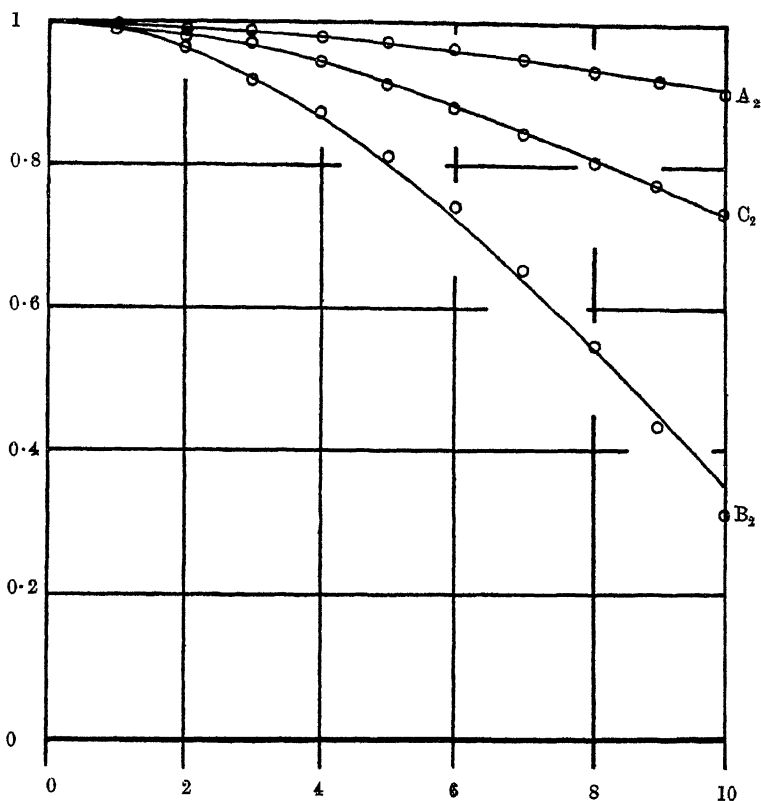


FIG. 12.—Serial correlations up to r_{10} for three experimental series (of 100 terms) with positively correlated (conjunct) differences.

adjacent first differences, is -0.5 and all the remaining correlations are zero, so the differences of a random series form a very simple type of disjunct series.

Oscillatory series.—Series for which the serial correlations change sign, being alternately positive and negative. These are very important in many forms of statistics (quite possibly they are the most frequent form), but I am not able to consider them in the

present Address, though I take one series with oscillatory differences as an illustration for analysis (Section V). The truly periodic series is a special case; an oscillatory series is not necessarily periodic. If, for example, we take a random series and form a derivative series by calculating the difference of u_s from the mean of the terms u_{s-r} to u_{s+r} , the derived series is oscillatory, but it is not periodic.

These are simple types; but clearly in the endless variety presented by facts we may expect to meet with compound series of any type, *e.g.*, conjunct series with an oscillatory series superposed (*cf.* Section V). It is also imaginable, obviously, that we might for such purposes of classification desire to go further and consider the serial correlations for second, third or n th differences.

In the immediately following work we are concerned only with *random series*, to which the ordinary theory of sampling applies, and two sub-types of *conjunct series*—

- (a) *conjunct series the differences of which are random.*
- (b) *conjunct series the differences of which are themselves conjunct series.*

We have concluded that if we take random samples from two conjunct series and work out the correlations between them, series of type (a) will tend to give a distribution of correlations certainly divergent from the distribution given by random samples from random series, more scattered, and *possibly* bimodal: series of type (b) will tend to give an entirely divergent and probably U-shaped frequency-distribution of the correlations. In the next section an experimental investigation is described to test these tentative conclusions.

As the distinctions seem to me of possible importance for much statistical work, I give in Figs. 13-15 illustrations of the three types—random series, conjunct series with random differences, and conjunct series with conjunct differences. Fig. 13 shows two random series; there is no secular trend, and the whole movement is highly irregular. The graphs are not, to the eye at least, very unlike graphs of some annual averages in meteorological data. Fig. 14 gives graphs of two series with random differences. We now get a marked “secular movement,” with irregular oscillations superposed on it. Finally, Fig. 15 gives two graphs of series with conjunct differences. The curves are smoothed out, the secular movements or long waves are conspicuous, but there are no evident oscillations of short duration. The graphs of both Fig. 14 and Fig. 15 could, I think, be matched from statistical data, but it is quite possible that what looked a good match to the eye would not seem at all a good match when subjected to strict analysis.

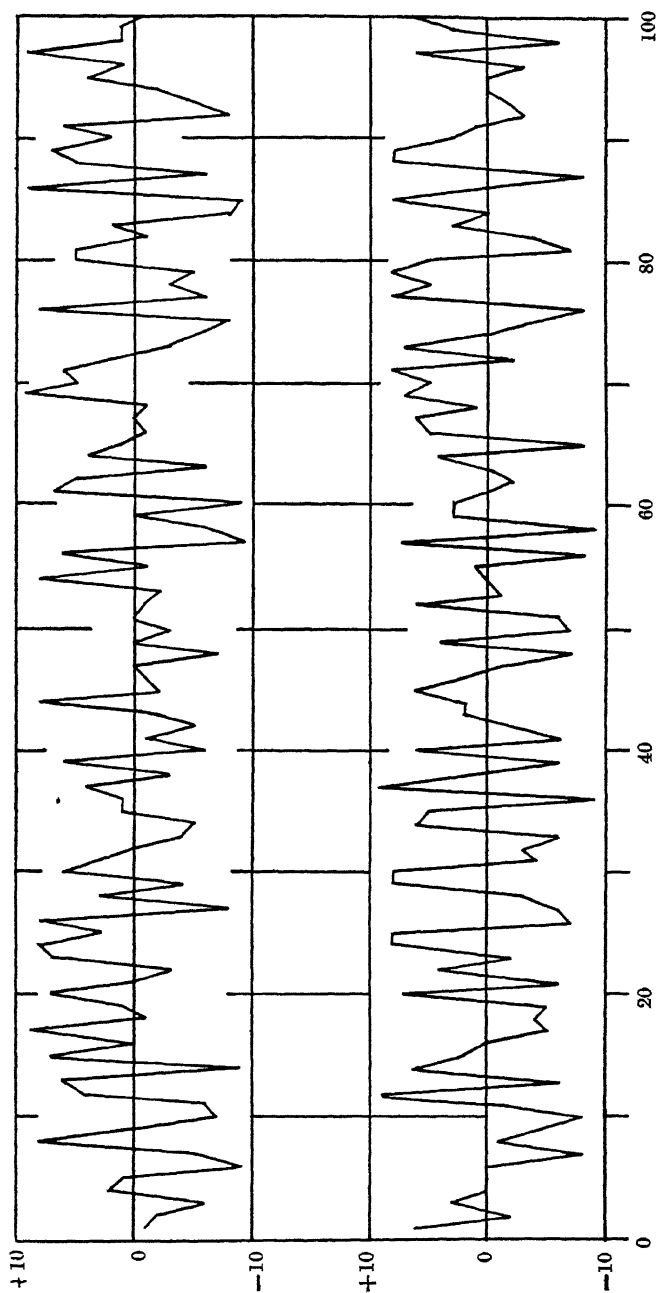


FIG. 13.—Two random series.

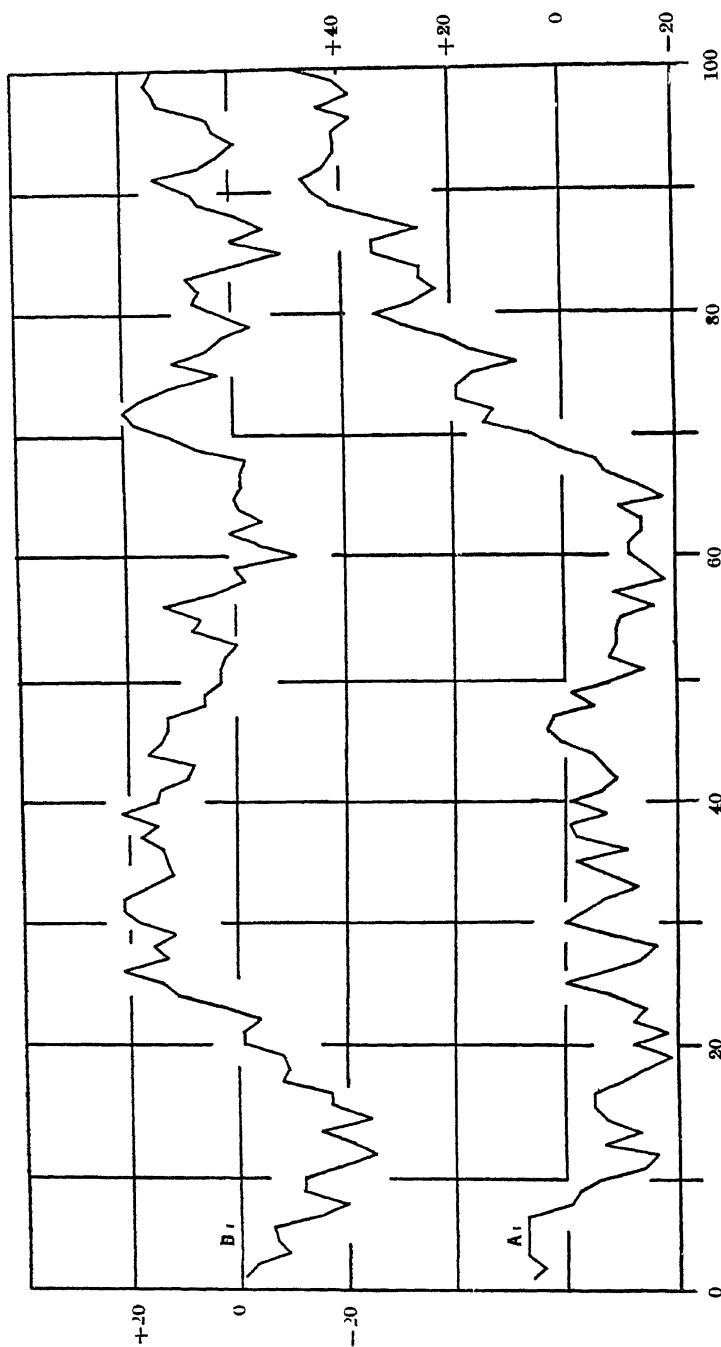


FIG 14.—Two series with random differences (conjunct series with random differences).

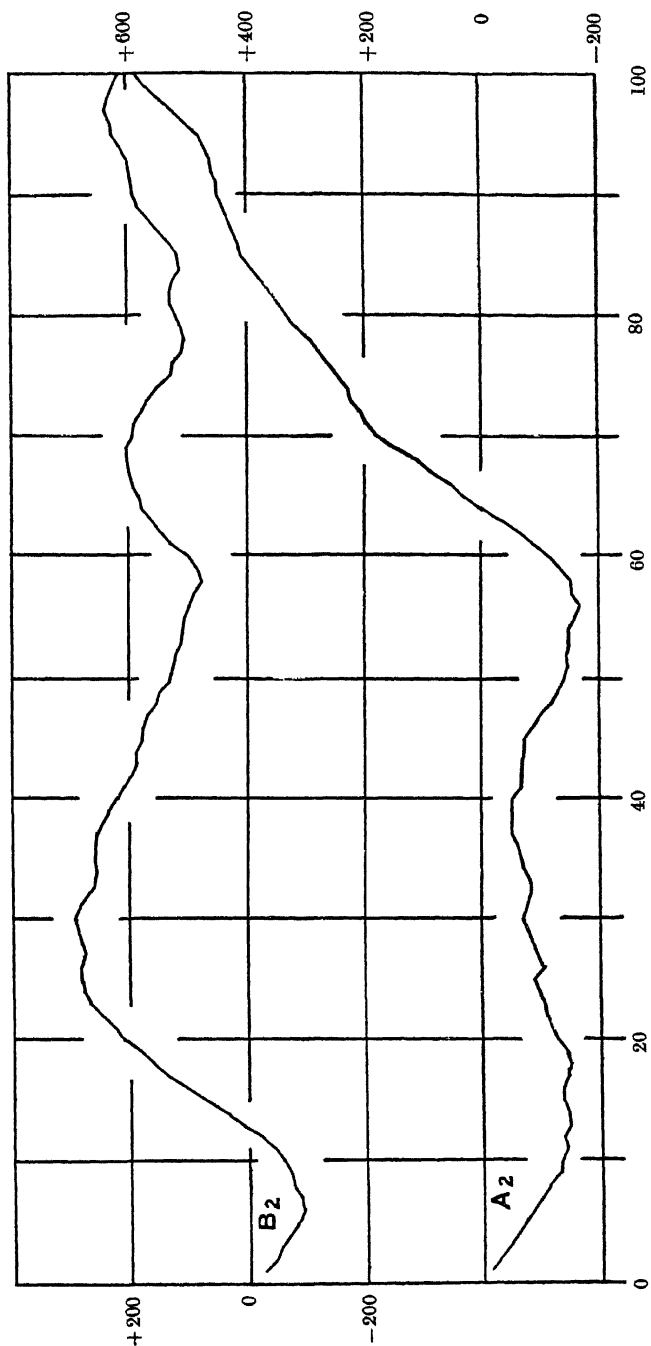


FIG. 15.—Two series with positively correlated differences (conjoint series with conjoint differences).

SECTION IV.—*Experimental investigations.*

When the main ideas developed in Sections II and III had been reached, I decided to carry out experimental tests. The fundamental random series were formed by drawing cards from a pack in the way described in a former paper*—in fact, the record used in that paper was employed as one series. The court cards were removed from two patience packs; black cards were reckoned as positive, red cards as negative and tens as zeros, so that the frequency-distribution in the pack was uniform from -9 to $+9$, with the exception that there were two zeros. The mean of this distribution is zero, and the standard deviation is $\sqrt{28.5}$, or 5.3385 . The pack was shuffled and a card drawn; thoroughly shuffled again and another card drawn, and so on. Every precaution was taken to avoid possible bias and ensure randomness. The use of a double pack helps, I think, towards this, as the complete series is repeated four times. Shuffling was very thorough after every draw; after shuffling, the pack was cut and, say, the fifth card from the cut taken as the card drawn, so as to avoid any possible tendency of the cards to cut at a black rather than a red, or a ten rather than an ace, and so on.

When the random series had been obtained, a series with random differences was calculated from it by adding term by term from the beginning. To obtain a series with correlated differences, the natural procedure would have been, as already suggested in Section III, to go on and obtain the second sum of the random series. But at the time the experiments were begun this did not strike me, and it seemed desirable to work with known correlations between the differences. I therefore added up the random series by successive groups of 11 terms, u_0 to u_{10} , u_1 to u_{11} , u_2 to u_{12} , and so on; this gave the difference series, and adding term by term gave the series with correlated differences, the serial correlations between the differences being $10/11$, $9/11$, $8/11$, . . . $1/11$, and thenceforward zero.

But the process used for sampling was very slow, and to shorten both the work of sampling and the arithmetic I adopted a procedure which was certainly very effective to that end, but proved itself by no means desirable in other respects; it tended, in fact, to give lumpy and irregular frequency-distributions. Had I fully realized its disadvantages as well as its advantages, I might rather have chosen to adopt the straightforward method of obtaining completely independent samples for every correlation to be calculated. This

* "On the Time Correlation Problem," *J.S.S.*, vol. lxxxiv, 1921; cf. pp. 517-18.

would have necessitated a much longer time for the investigation, but I had, in fact, to make one supplementary series of experiments by the better method. The procedure used was this for each type of series. I formed three series of 100 observations each, A, B, C. I then divided up each series into 10 sets of 10 observations. Finally, for the correlations I combined every set of A with every set of B (100 pairs), every set of A with every set of C (100 pairs), and every set of B with every set of C (100 pairs). I thus obtained 300 correlations each based on 10 observations, but only 30 completely independent sets of 10 observations were used in the whole set. As a control I carried out another set, however, in the same way with three series, D, E, F. To make the experimental test complete and afford some control of the method, I began with the random series where the theory is known and familiar.

(A.) *Random series.*

The distribution of correlations in this case should be symmetrical about zero, and, though it can hardly be normal, should approximate to the normal form with the mode at zero; the standard deviation should be $1/\sqrt{10}$, or 0.3162.* The results given by experiment are shown in Table VIII, which shows separately the distributions for

TABLE VIII.—Frequency-distributions of correlations for samples of 10 observations from random series.

Correlation.	Frequency.		
	Series A ₀ , B ₀ , C ₀ .	Series D ₀ , E ₀ , F ₀ .	Total.
— 0.9 — — 1.0	—	—	—
— 0.8 — — 0.9	1	—	1
— 0.7 — — 0.8	1	2	3
— 0.6 — — 0.7	4	8	12
— 0.5 — — 0.6	9	8	17
— 0.4 — — 0.5	18	13	31
— 0.3 — — 0.4	37	31	68
— 0.2 — — 0.3	30	37	67
— 0.1 — — 0.2	24	20	44
0 — — 0.1	32	33.5	65.5
0 — + 0.1	27	30.5	57.5
+ 0.1 — + 0.2	38	37	75
+ 0.2 — + 0.3	28	25	53
+ 0.3 — + 0.4	26	20	46
+ 0.4 — + 0.5	12	15	27
+ 0.5 — + 0.6	6	9	15
+ 0.6 — + 0.7	3	8	11
+ 0.7 — + 0.8	1	3	4
+ 0.8 — + 0.9	2	—	2
+ 0.9 — + 1.0	1	—	1
Total	300	300	600

* As we are sampling from material that is not merely uncorrelated but completely independent, the expression for the standard error of r reduces to its simplest form.

each set of three series; Fig. 16 gives a graph of the results for the two sets combined. It will be seen that the distributions are at least moderately symmetrical, though by no means as regular as might be wished. The means and standard deviations are as follows:—

A_0, B_0, C_0	...	$M = -0.019.$	$\sigma = 0.3191.$
D_0, E_0, F_0	...	$M = -0.0075.$	$\sigma = 0.3263.$
Together	...	$M = -0.013.$	$\sigma = 0.3227.$

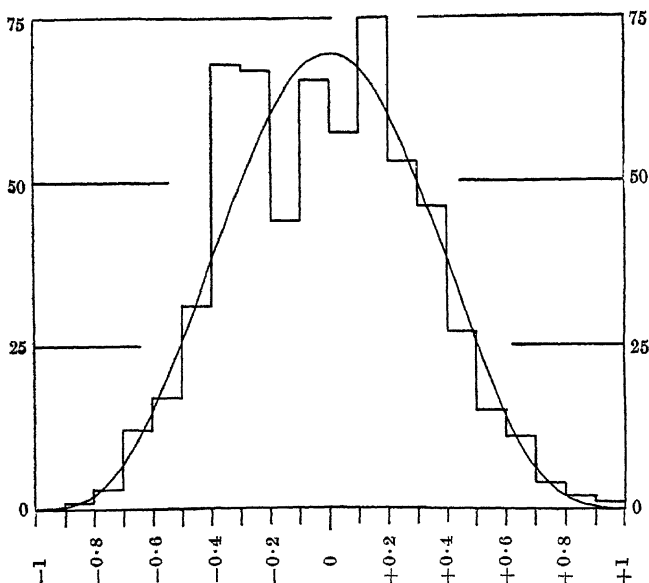


FIG. 16.—Frequency-distribution of 600 correlations between samples of 10 observations from random series (Table VIII).

The standard error of the mean with 300 observations is 0.0183, with 600 observations, 0.0129: the divergence from zero is just greater than the standard error in the first case, and less than half the standard error in the second; for the two sets together it is just equal to the standard error. The standard error of the standard deviation is 0.0129 for 300 observations, 0.0091 for 600 observations; all the divergences are well within the standard error. Mean and standard deviation agree very fairly with theory: it is only the irregularity of the distribution which is not pleasing.

To get some measure of the divergence in this respect, I calculated Professor Pearson's symmetrical limited range-curve with the theoretical value of the standard deviation:—

$$y = 69.846 (1 - x^2)^{3.5}.$$

This is the curve of which the graph is shown in Fig. 16. The principal excess of frequency is in the interval -0.3 to -0.4 , but there are also marked excesses at -0.2 to -0.3 , and $+0.1$ to $+0.2$, compensated by deficiencies over the range -0.2 to $+0.1$. Grouping the frequencies below -0.7 and above $+0.7$, χ^2 comes to 29.36 and n' is 16, so that P is 0.015, a low though not impossible value. The odd thing is that the two separate distributions from A_0, B_0, C_0 , and from D_0, E_0, F_0 , agree in the sign of the most marked divergences, and this can hardly be anything but an unfortunate fluke. If the two distributions are treated as forming a two-row contingency table, with the same grouping χ^2 comes to 6.40 only and n' is 16, which gives $P = 0.97$: the two distributions agree much too well with each other even in their irregularities.

The serial correlations for these random series A_0 to F_0 will be found in Table X below, p. 36. The number of observations on which they are based range from 100 down to 90, so that the standard errors range from 0.1 to 0.105. Whichever value we take, there are 47 of the correlations less than the standard error, 13 between once and twice the standard error, and none greater. Expectation, assuming normal distribution, would be 41 : 16 : 3.

(B.) *Series with random differences.*

The frequency-distributions of the correlations for samples of 10 observations from these series are shown in Table IX. It is evident that both the distributions, from A_1, B_1, C_1 , and D_1, E_1, F_1 , respectively, are much more widely dispersed than the correlations from samples of random series, and the set D_1, E_1, F_1 , like the total, is clearly bimodal. This is what the argument of Section III led us to expect. But the two contributions from A_1, B_1, C_1 , and from D_1, E_1, F_1 , differ much too largely from each other to enable us to attach much weight to the pool of the two. To begin with, the second set is more widely dispersed than the first: the respective standard deviations are:—

A_1, B_1, C_1	...	...	...	...	0.500
D_1, E_1, F_1	...	...	...	...	0.601
Combined series	...	...	...	...	0.553

In the second place the set A_1, B_1, C_1 is not clearly bimodal, but merely irregular. At the same time the distribution, when I obtained it, seemed rather puzzling. The sub-contributions were rather suggestive of outlying modes, and it will be noticed that in the total of 300 observations the highest frequency is that for the interval $+0.6$ to $+0.7$. I felt some doubt whether the distribution was

really bimodal or merely flat-topped; it was this doubt, and the desire to clear it up, which originally led me to carry through the experiments with the second series D_1, E_1, F_1 . The second series is quite clearly bimodal, with modes *circa* 0.7, and these modes remain marked when the results of the two sets are taken together. But as I have said, not much weight can be attached to this when the two components are so different.

TABLE IX.—Frequency-distributions of correlations for samples of 10 observations from series with random differences (conjunct series with random differences).

Correlation	Frequency.			Series X_1 .
	Series A_1, B_1, C_1 .	Series D_1, E_1, F_1 .	Total A_1 to F_1 .	
— 0.9 — — 1.0	2	7	9	8
— 0.8 — — 0.9	11	17	28	21
— 0.7 — — 0.8	14	29	43	24
— 0.6 — — 0.7	18	19	37	34
— 0.5 — — 0.6	21	22	43	27
— 0.4 — — 0.5	17	13	30	38
— 0.3 — — 0.4	20	11	31	42
— 0.2 — — 0.3	12	14	26	41
— 0.1 — — 0.2	22	13	35	33
0 — — 0.1	21	8	29	31
0 — + 0.1	10	7	17	43
+ 0.1 — + 0.2	18	11	29	34
+ 0.2 — + 0.3	13	10	23	28
+ 0.3 — + 0.4	18	12	30	33
+ 0.4 — + 0.5	20	18	38	34
+ 0.5 — + 0.6	18	18	36	26
+ 0.6 — + 0.7	24	20	44	31
+ 0.7 — + 0.8	13	28	41	30
+ 0.8 — + 0.9	7	16	23	34
+ 0.9 — + 1.0	1	7	8	8
Total	300	300	600	600

I decided therefore that I must carry through for this case another series of experiments in which all the sets of observations should be taken independently. To keep the same frequency-distribution as before for the fundamental random series, counters (cardboard wads for No. 12 cartridges) were taken and a set of 20 was inscribed with the numbers from — 9 to 0 and 0 to + 9. Fifteen such sets, or 300 counters in all, were prepared and put in a bag: a counter was drawn at random, noted, put back, stirred up with the others, another drawn, and so on. Ten such drawings having been made, the addition of the numbers, step by step, gave the sum series for the correlation: another set of ten drawings gave its fellow-set, and the

correlation between them could then be worked out. Six hundred correlations were worked out in this way, and the frequency-distribution is shown in the last column of Table IX under the heading "Series X_1 ." A graph is given in Fig. 17. The mean and standard deviation are:—

$$M = +0.0093$$

$$\sigma = 0.513.$$

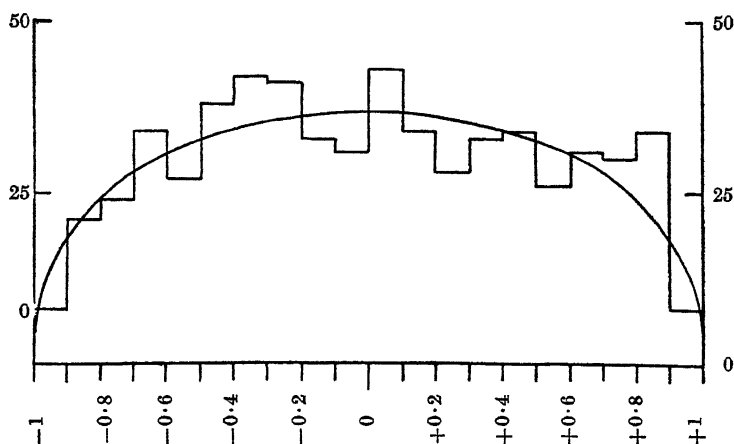


FIG. 17.—Frequency-distribution of 600 correlations between samples of 10 observations from conjunct series with random differences (Series X_1 , Table IX).

The standard deviation lies accordingly between those for A_1 , B_1 , C_1 , and D_1 , E_1 , F_1 , but nearer the former. There is no indication, in the total, of bimodality. The graph shows Pearson's symmetrical curve of limited range with the same range and standard deviation,

$$y = 36.717 (1 - x^2)^{0.40152},$$

which in this case gives a curve somewhat resembling a semi-ellipse. This gives too high a frequency at both ends, so I have some doubt whether it truly represents the actual form; but, even so, on testing the distribution by the χ^2 method, I find $\chi^2 = 21.69$, $n' = 20$, which gives $P = 0.30$, indicating quite a passable fit.

I think we must accept Series X_1 as giving the best evidence at present available as to the form of the distribution, and take it as unimodal. But I remain exceedingly puzzled. I booked up the correlations of Series X_1 by separate hundreds; the last hundred was the most widely dispersed (s.d. 0.553), and as clearly bimodal as D_1 , E_1 , F_1 . The distribution seems to be in some way highly unstable and liable to break up into a distribution with relatively low central

frequencies and much higher frequencies round about 0.6 to 0.8. To endeavour to throw light on the reasons for this instability, I worked out the serial correlations for the fundamental random series A_0 to F_0 inclusive and give them in Table X. If, it occurred to me, owing to imperfect fulfilment of the conditions of simple sampling or otherwise, series D_0 , E_0 , and F_0 proved to be on the whole slightly conjunct series, we might have quite enough to account for the difference between the results given by D_1 , E_1 , F_1 and by A_1 , B_1 , C_1 , having regard to the results of the next section. As we are dealing with samples of 10 observations only, we are not really concerned with r_{10} , the last correlation given in Table X; omitting this and looking at the others, it will be seen that there is a certain preponderance of negative correlations in A_0 , B_0 , C_0 , and of positive correlations in D_0 , E_0 , F_0 : there are, in fact, 16 negatives out of the 27 correlations in A_0 , B_0 , and C_0 , 16 positive out of the 27 in D_0 , E_0 , and F_0 . But the differences look hardly adequate to account for the divergence between the second and third columns of Table IX.*

TABLE X.—Serial correlations for the random series A_0 to F_0 .

r .		A_0 .	B_0	C_0	D_0 .	E_0 .	F_0 .
1	...	— 0.130	— 0.089	+ 0.080	+ 0.007	+ 0.014	+ 0.071
2	....	— 0.075	— 0.005	+ 0.010	+ 0.133	+ 0.014	— 0.191
3	..	— 0.009	— 0.068	— 0.001	+ 0.094	+ 0.085	+ 0.010
4	....	— 0.167	— 0.147	— 0.059	— 0.098	— 0.028	+ 0.071
5	.	— 0.116	+ 0.087	— 0.083	+ 0.035	+ 0.037	— 0.020
6	..	+ 0.047	— 0.141	— 0.043	— 0.027	— 0.127	+ 0.006
7	...	— 0.090	+ 0.141	— 0.056	— 0.005	+ 0.040	— 0.016
8	....	— 0.024	+ 0.184	+ 0.093	+ 0.073	+ 0.061	— 0.055
9	.	— 0.037	— 0.015	— 0.035	+ 0.006	— 0.170	— 0.044
10	..	— 0.128	— 0.020	— 0.026	— 0.059	— 0.047	— 0.117

(C.) *Series with correlated differences.*

The results of the experiments with these series are given in Table XI, and a graph of the frequency-distribution for the 600 observations from the two sets combined is shown in Fig. 18. In complete accordance with expectation, the distribution is U-shaped; a little over one-third of the correlations from the samples exceeding ± 0.9 and about 58 per cent. exceeding ± 0.8 . The results from the first set, A_2 , B_2 , C_2 , and the second set, D_2 , E_2 , F_2 , are in good

* Treating these as a two-row contingency table, I make $\chi^2 = 38.57$, $\nu = 20$, $P = 0.01$ roughly.

accordance with each other, but the second set shows slightly greater dispersion. The form of distribution in this case is indeed so marked that it is brought out quite clearly by a very short series of trials.

TABLE XI.—Frequency-distributions of correlations for samples of 10 observations from series with correlated differences (conjunct series with conjunct differences).

Correlation.	Frequency.		
	Series $A_2, E_2, C_2.$	Series $D_2, E_2, F_2.$	Total.
— 0.9 — — 1.0	51	61	112
— 0.8 — — 0.9	30	36	66
— 0.7 — — 0.8	20	17	37
— 0.6 — — 0.7	11	12	23
— 0.5 — — 0.6	11	9	20
— 0.4 — — 0.5	10	8	18
— 0.3 — — 0.4	7	4	11
— 0.2 — — 0.3	5	6	11
— 0.1 — — 0.2	4	1	5
0 — — 0.1	6	1	7
0 — + 0.1	8	2	10
+ 0.1 — + 0.2	7	3	10
+ 0.2 — + 0.3	4	1	5
+ 0.3 — + 0.4	2	10	12
+ 0.4 — + 0.5	5	4	9
+ 0.5 — + 0.6	6	6	12
+ 0.6 — + 0.7	12	14	26
+ 0.7 — + 0.8	20	15	35
+ 0.8 — + 0.9	32	31	63
+ 0.9 — + 1.0	49	59	108
Total	300	300	600

It is an interesting question, though of more theoretical than practical importance, whether the distribution is strictly U-shaped, with the frequency increasing indefinitely towards unity at either end of the range, or whether there is a true mode in the neighbourhood of unity. Table XII gives a detailed analysis of the distribution of correlations exceeding 0.9 at either end of the range. The figures are naturally irregular, but taking those for both positive and negative correlations together, a mode is suggested between 0.98 and 0.99.* The bimodality met with in some of the sub-series for series with random differences suggests that as the correlation between differences is gradually increased from zero, the distribution

* But even beyond 0.99 there is no rapid falling-off in frequency. Of the 24 coefficients numerically exceeding 0.99, 11 numerically exceed 0.995.

becomes bimodal, and the modes shift out to the extremities of the range; but this is rather a speculative deduction from the facts observed.

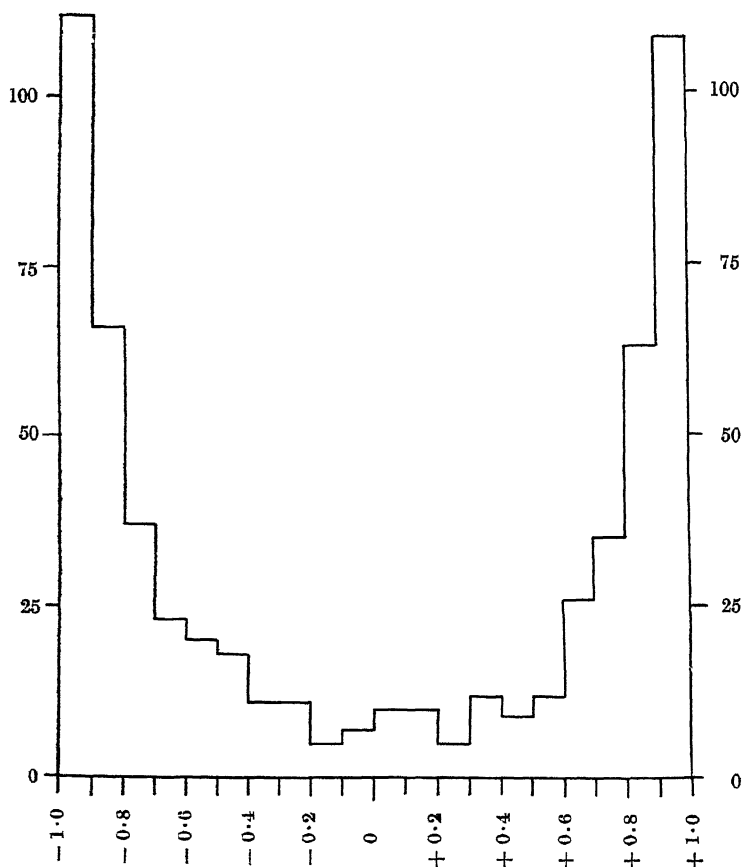


FIG. 18.—Frequency-distribution of 600 correlations between samples of 10 observations from conjunct series with conjunct differences (Table XI).

The experimental work has thus completely borne out the tentative conclusions reached in Section III, and the general result is clear. Considering only the two simple types of conjunct series, those with random differences and those with conjunct differences respectively, correlations between samples of the first type are subject to a much higher standard error than that given by the usual formula, but do not tend definitely to mislead; correlations between samples of the second type tend definitely to be “nonsense-

correlations"—correlations approaching plus or minus unity in value. The tentative answer to the problem of my title is therefore this: that some time-series are conjunct series with conjunct differences, and that when we take samples from two such series the distribution of correlations between them is U-shaped—we tend to get high positive or high negative correlations between the samples, without any regard to the true value of the correlation between the series that would be given by long experience over an indefinitely extended time.

TABLE XII.—Detailed analysis of the distribution of correlations exceeding ± 0.9 in Table XI.

Correlation.	Frequencies of correlations.		
	Positive.	Negative.	Together.
0.99 — 1.00	10	14	24
0.98 — 0.99	16	19	35
0.97 — 0.98	17	7	24
0.96 — 0.97	14	13	27
0.95 — 0.96	4	17	21
0.94 — 0.95	7	7	14
0.93 — 0.94	13	11	24
0.92 — 0.93	12	8	20
0.91 — 0.92	7	6	13
0.90 — 0.91	8	10	18
Total	108	112	220

Suppose we form a random series, for which the mean of the terms is zero, and regard each term as representing an observation during one unit of time, *e.g.*, an annual observation. Obviously this series is not correlated with the time. Form the first sum of the random series. This series will swing about above and below the zero base-line, but will not tend as the length of the series is increased to be correlated with the time. Now form the second sum of the random series, thus obtaining a conjunct series with conjunct differences. The swings above and below the base-line will now be smoother, longer and of greater amplitude, but still as the length of the series is increased there will be no tendency for it to be correlated with the time. Now I mentioned early in this Address the view that to interpret such "nonsense-correlations" as are here considered as implying causation is to "ignore the common influence of the time-factor," or as it has otherwise been put, the fact that both variables are correlated with the time. And I added that, while I could not accept the phrase, there was a special and

definite sense in which it might be said to cover the explanation. We see, in fact, that conjunct series with conjunct differences are *not* necessarily correlated with the time, so the phrase criticized is at least inexact. But, successive differences being correlated with each other, there is a tendency for the curve to rise or fall consistently over more or less prolonged periods; there is a greater or less degree of *continuity* with time, and hence a tendency for the variable to be correlated with the time *over short samples*. This is, I think, the only sense in which the "common influence of the time factor" can be held to be responsible.

I give my answer to the problem as a tentative answer only, for I quite recognize that the discussion is inadequate and incomplete. The full discussion of the mathematical problem—given two series, each with specified serial correlations, required to determine the frequency-distribution of correlations between samples of n consecutive observations—I must leave to more competent hands. It is quite beyond my abilities, but I hope that some mathematician will take it up. The results that he may obtain may seem to be of mere theoretical importance, for in general we only have the sample itself, which may be quite inadequate for obtaining the serial correlations. But to take such a view would, I think, be short-sighted. The work may not lead, it is unlikely to lead, to any succinct standard error, or even frequency-distribution applicable to the particular case. But only such direct attack can, it seems to me, clear up the general problem; show us what cases are particularly liable to lead to fallacious conclusions, and in what cases we must expect a dispersion of the sample-correlations greater than the normal. I have only considered two cases, and there is more variety in fact than this—compound curves of every sort* may occur. If my view is correct, that the serial correlations of the difference series are the really important factor, even the special solution for the special problem may not be so hopeless as at first sight it may seem; for the sample may be a more adequate basis for the approximate determination of the difference correlations than for the determination of the serial correlations of the series itself.

* The mortality curve of Fig. 1 does not suggest a conjunct series with conjunct differences, but rather a segment of a series that might be regarded as compound—a conjunct series with an oscillatory series superposed like the Beveridge series of the next section. It may be noted that when we separate out the oscillations in such a series by taking the difference of u_s from the mean of the terms u_{s-r} to u_{s+r} , we are in fact splitting up the series into (1) an oscillatory series, (2) a conjunct series.

In a mathematical series any term u_s is some definite mathematical function of s , and has precise and definite mathematical relations to the terms that precede and the terms that follow. In a statistical series u_s is no longer a definite mathematical function of s , and no longer has precise and definite relations to the terms that precede and follow it. I have suggested replacing, as we usually have to do in statistics, the conception of mathematical functionality by the conception of correlation, and thus specifying the characteristics of the series by its serial correlations. Apart from its application to the theory of sampling in time-series, such a specification is of interest in itself as a method of analysis. I give an illustration or two in the next section.

SECTION V.—*Serial correlations for Sir William Beveridge's index-numbers of wheat prices in Western Europe; and for rainfall at Greenwich.*

The great majority of statistical series that we possess seem to me to be far too short to afford any adequate basis for determining the serial correlations; few of them extend even for as long as a century. And brevity of the sample has more than one disadvantage. That it may not be adequately representative is the primary fault. But, further, it must be remembered that in determining r_1 from a series of n terms we use u_1 to u_{n-1} for the one series, u_2 to u_n for the other; in determining r_2 we use u_1 to u_{n-2} for the one series, u_3 to u_n for the other, and so on. Each successive correlation in the series is determined from different observations, and if k is not small compared with n , the number of terms in the given data, r_k may be seriously inconsistent with r_1 . Moreover, the equation that we use for determining the difference correlations from the serial correlations (the ρ 's from the r 's) assumes that the "end-effects" are negligible. Bearing these considerations in mind, it seemed to me that Sir William Beveridge's index-numbers for wheat prices in Western Europe,* a series extending over more than 300 years, was about the only one worth detailed study. Following his practice in the periodogram analysis,† I have used only the 300 years 1545 to 1844 inclusive, but it must be understood that I have worked on the index-numbers themselves, not the derived figures obtained by taking the ratio of each index-number to the average of the 31 of which it forms the centre, which were used for periodogram analysis.

* *Economic Journal*, vol. xxxi, p. 429, December, 1921.

† *J.S.S.*, vol. lxxxv, p. 412, 1922.

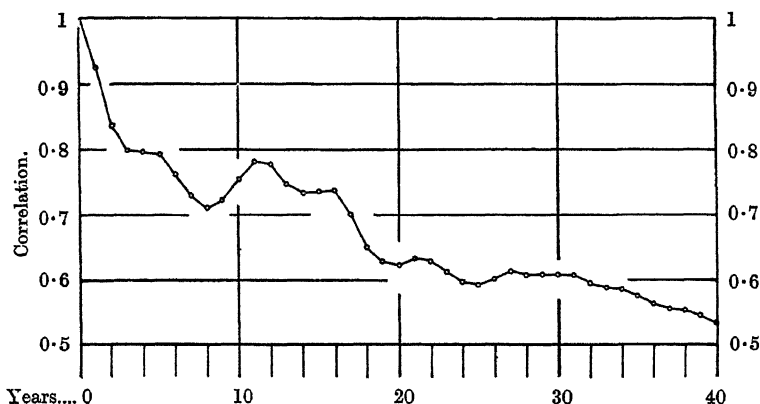
The work was executed as follows, without any grouping of observations. The squares of all the index-numbers were first added on a Burroughs Adding Machine, and the slip of squares retained. The machine was then "split," and the numbers themselves entered in duplicate on the right and left halves of the machine and added. The resulting slip was then cut longitudinally down the centre; by putting these two half-slips against each other so that observation s of the first is opposite observation $s + k$ of the second, corresponding observations could be added in one's head and the squares entered direct on the machine. Let us call an observation on the first slip X and on the second slip Y . Then the slip thus obtained gives $S(X + Y)^2$. $S(X^2)$ will be obtained from the slip of squares by deducting k squares from the bottom, and $S(Y^2)$ by deducting k squares from the top, and

$$S(X + Y)^2 - S(X^2) - S(Y^2) = 2S(XY).$$

The means M_x and M_y are obtained from the addition-slip for the observations themselves by deducting k observations from the bottom and the top respectively, and the reductions of the mean product and the standard deviations to the mean are effected in the usual way. The slips giving $S(X + Y)^2$ were, of course, read over and checked, and I hope the results are accurate. A serious blunder can hardly escape the mere graphic check of plotting the results—one error was so found. Another partial check is given by the fact that, since the index-numbers are whole numbers, $S(XY)$ must be a whole number, or $2S(XY)$ must be even. This check led to the discovery of four minor errors that had escaped detection in the first reading over; one of these only affected the correlation coefficient in the sixth place of decimals, one in the fifth place and two in the fourth place. I had originally intended only carrying the calculations up to r_{30} , one-tenth of the whole number of observations, thinking this might be as far as it was safe to go, but some curiosity as to whether there would be any apparent effect of the Brückner cycle of 35 years led me to continue up to r_{40} . The correlations are given in Table XIII, and a graph is shown in Fig. 19. The correlations are all positive, as they evidently must be in a series that sweeps up from values round about 20 or 30 in the earlier years to 100, 200 and over in the later years. They fall away at first with some rapidity to a minimum of 0.71 at r_8 ; there is then a large broad hummock in the curve followed by some minor oscillations, and finally, from about r_{25} onwards, the curve tails away comparatively smoothly to 0.53 at r_{40} . There is no trace of any special maximum suggesting the Brückner cycle.

TABLE XIII.—Serial correlations for Sir William Beveridge's index-numbers for wheat prices in Western Europe, 1545-1844. All correlations are positive.

k .		r_k .	k .		r_k .
1	....	0.92240	21	....	0.63432
2	...	0.83353	22	....	0.62901
3	....	0.79639	23	...	0.61136
4	....	0.79560	24	....	0.59658
5	....	0.79146	25	....	0.59193
6	....	0.76013	26	....	0.60030
7	....	0.72850	27	....	0.61241
8	....	0.71063	28	....	0.60680
9	....	0.72170	29	....	0.60770
10	....	0.75356	30	....	0.60789
11	....	0.78013	31	...	0.60877
12	....	0.77661	32	....	0.59589
13	....	0.74508	33	....	0.58851
14	....	0.73330	34	....	0.58553
15	....	0.73625	35	....	0.57505
16	....	0.73609	36	....	0.56441
17	....	0.70015	37	....	0.55683
18	....	0.65054	38	....	0.55342
19	....	0.62692	39	....	0.54495
20	....	0.62319	40	....	0.53479

FIG. 19.—Serial correlations up to r_{40} for Sir William Beveridge's index-numbers of wheat prices in Western Europe, 1545-1844 (Table XIII).

Clearly the series of index-numbers is a conjunct series with oscillatory differences, that is probably marked oscillatory components. The next step is to obtain from the correlations of Table XIII the serial correlations for the differences. These are shown, for a

few selected values of the interval h , in Table XIV. Consider first the column for $h=1$, giving the limit values (equation (4), Appendix II) for the serial correlations of the differences between consecutive years, and compare with the graph at the top of Fig. 20. It will be seen from the graph that up to about ρ_{26} the correlations are fairly regularly oscillatory, but after this they become more irregular and the

TABLE XIV.—Index-numbers of wheat prices in Western Europe: limit values of the serial difference correlations, derived from the correlations of Table XIII by equation (5), Appendix II, for various values of the interval h .

k .	$h = 1$.	$h = 5$.	$h = 6$.	$h = 11$.	$h = 15$.
	$1\rho_k$.	$5\rho_k$.	$6\rho_k$.	$11\rho_k$.	$15\rho_k$.
1	+ 0.073	+ 0.693	+ 0.677	+ 0.715	+ 0.712
2	— 0.333	+ 0.341	+ 0.335	+ 0.455	+ 0.421
3	— 0.234	+ 0.117	+ 0.156	+ 0.338	+ 0.314
4	+ 0.022	— 0.127	+ 0.009	+ 0.288	+ 0.349
5	+ 0.175	— 0.409	— 0.249	+ 0.197	+ 0.391
6	+ 0.002	— 0.437	— 0.534	+ 0.065	+ 0.311
7	— 0.089	— 0.367	— 0.439	+ 0.025	+ 0.222
8	— 0.186	— 0.288	— 0.303	— 0.005	+ 0.154
9	— 0.134	— 0.205	— 0.186	— 0.030	+ 0.164
10	+ 0.034	— 0.049	— 0.051	— 0.113	+ 0.235
11	+ 0.194	+ 0.154	+ 0.143	— 0.156	+ 0.312
12	+ 0.180	+ 0.299	+ 0.297	+ 0.004	+ 0.274
13	— 0.127	+ 0.309	+ 0.281	+ 0.137	+ 0.094
14	— 0.095	+ 0.283	+ 0.277	+ 0.178	— 0.120
15	+ 0.020	+ 0.230	+ 0.243	+ 0.193	— 0.257
16	+ 0.231	+ 0.138	+ 0.187	+ 0.155	— 0.112
17	+ 0.088	— 0.013	+ 0.018	+ 0.076	— 0.055
18	— 0.167	— 0.133	— 0.150	— 0.080	— 0.159
19	— 0.128	— 0.182	— 0.173	— 0.147	— 0.241
20	— 0.096	— 0.196	— 0.182	— 0.191	— 0.228
21	+ 0.106	— 0.162	— 0.167	— 0.184	— 0.106
22	+ 0.080	— 0.131	— 0.177	— 0.252	— 0.052
23	— 0.018	— 0.083	— 0.177	— 0.317	— 0.078
24	— 0.065	— 0.099	— 0.136	— 0.289	— 0.139
25	— 0.084	— 0.113	— 0.108	— 0.259	— 0.193
26	— 0.024	— 0.102	— 0.039	— 0.210	—
27	+ 0.114	— 0.000	+ 0.004	— 0.147	—
28	— 0.042	+ 0.033	— 0.002	— 0.072	—
29	+ 0.005	+ 0.080	+ 0.060	+ 0.068	—
30	— 0.004	+ 0.117	+ 0.092	—	—
31	+ 0.089	+ 0.127	+ 0.143	—	—
32	— 0.035	+ 0.054	+ 0.079	—	—
33	— 0.028	+ 0.040	+ 0.041	—	—
34	+ 0.048	+ 0.044	+ 0.061	—	—
35	+ 0.001	+ 0.018	—	—	—
36	— 0.020	—	—	—	—
37	— 0.027	—	—	—	—
38	+ 0.033	—	—	—	—
39	+ 0.011	—	—	—	—

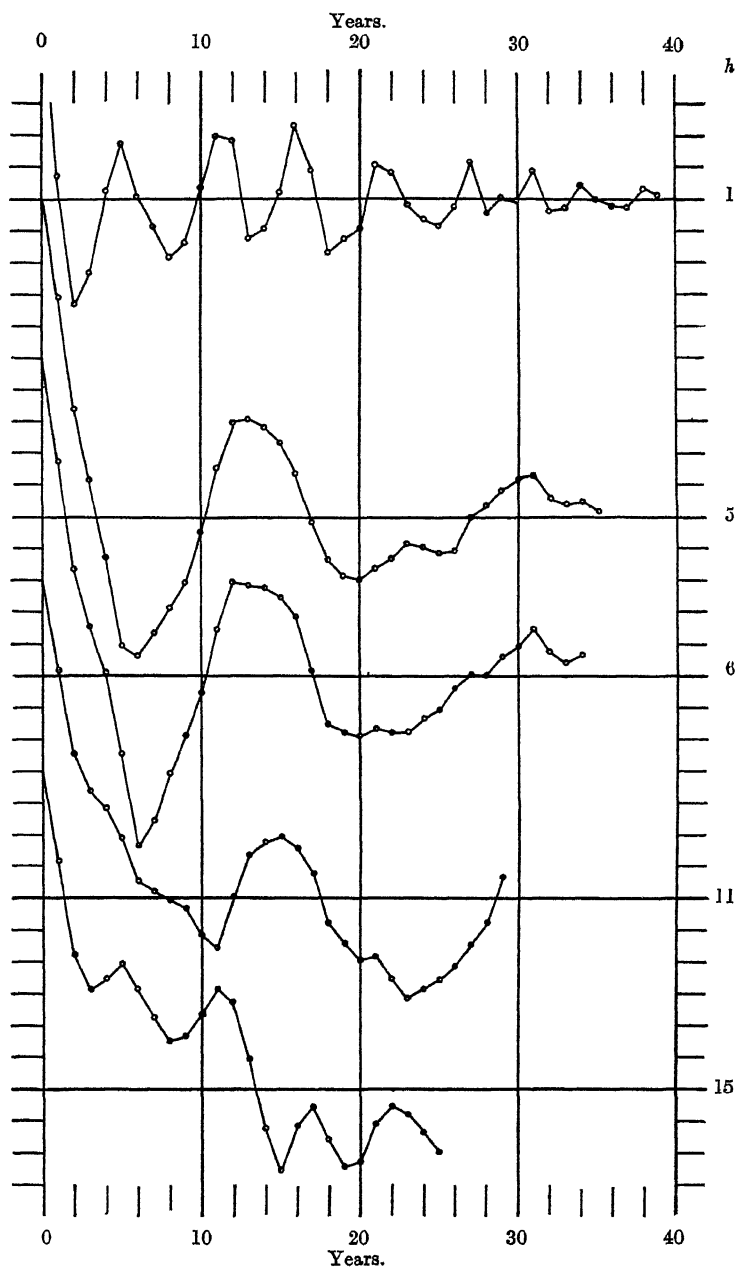


FIG. 20.—Serial difference correlations for the index-numbers of wheat prices in Western Europe: intervals of differencing $h = 1, 5, 6, 11$ and 15 years respectively (Table XIV).

oscillations diminish in amplitude. At a rough judgment by eye, I should put the successive maxima and minima at about 2.2, 5, 8, 11.5, 13.7, 16.2, 18.7, 21.5 and 22.3; the intervals for the half-oscillations would be on this reckoning 2.8, 3, 3.5, 2.2, 2.5, 2.5, 2.8, and 3 years, giving an average duration for the oscillation of about 5.6 years. Beveridge finds four marked periods* between 5.100 and 5.960 years inclusive, of intensities (amplitudes squared) in round numbers 42, 23, 33 and 23. Of shorter periods he accepts only three as definite—one of period 2.735 and intensity roundly 8, one of length 3.415 and intensity roundly 16, and the third of length 4.415 and intensity roundly 16. Differencing tends, of course, to emphasize the shorter periods,† but it is a little surprising to find the effect of the terms of about 5 to 6 years' duration standing out, apparently, almost by themselves. After the first minimum only one correlation exceeds 0.2, viz., ρ_{16} , and the regularity of the oscillations is greater than one might have expected.

To bring out the oscillations of longer duration, if there are any, it is only necessary to work out the difference-correlations for an interval longer than one year. Judging from the first curve, the predominant oscillations of shorter duration were of 5 to 6 years' duration. These oscillations would be practically eliminated by taking 5 years or 6 years for the interval of differencing h , and so the serial correlations for these values of h were worked out next.‡ The figures are given in Table XIV, and the graphs are the second and third in Fig. 20. The two curves are very like each other; both give a good clean sweep and the correlations are considerably higher than in the last case. The similarity between the two extends to points of detail. The drop to the first minimum is abrupt, the respective minima being -0.437 and -0.534 , both at 6 years. Thence there is a sharp rise to a maximum in the neighbourhood of year 13, with correlations of about 0.3, this maximum being flat and the slope up to the maximum steeper than the slope away from it. The third half-oscillation, below the base-line, is double-humped, clearly in the first case, less markedly in the second. We seem to have here as the predominant factors Sir William Beveridge's periods.

* I refer specifically to his table of "Apparent Periods" on pp. 444-45.

† As regards the effect of differencing on the amplitudes of harmonic terms, cf. my paper on the "Time Correlation Problem," *J.S.S.*, vol. lxxxiv, 1921, especially Table I, p. 507.

‡ $\rho_{h,k}$ is the correlation between $u_s + h - u_s$ and $u_{s+h+k} - u_{s+h}$; hence $\rho_{1,1}$, for example, is the correlation between consecutive differences taken with interval 1.

Length.					Intensity.
12.840	...	...	...	...	46.00 +
15.225	...	...	...	...	76.16 +
17.400	...	...	...	...	54.12 +

Scaling off on my original chart the lengths from the zero-point to the points at which the curves cut the base-line for the first, second and third times, the durations suggested for the oscillations by the first quarter-period and the following half-periods would be 13.6, 13.6 and 13.4 years from the first curve, and 16, 12.6, 13.4 years from the second curve. The first minimum in the following half-oscillation is at 20 years, nearly, in both curves, suggesting a duration for the oscillation of about 14.3 years. The second minimum I should put at about 25 years in the first curve and 23 years in the second, suggesting durations of about 16.7 and 15.3.

For my next case, again with the intention of eliminating as far as possible the oscillations shown in the curve for $h = 1$, I took $h = 11$. The form of the curve now obtained, with so long an interval of differencing, suggests that we have, superposed on the effect of the oscillations, some effect of either very long oscillations or secular movement. Judging therefore rather by the maxima and minima, the first maximum suggests oscillations of a duration near 15 years: the second minimum, placing it at 23 years, would suggest a duration of 15.3.

● For my final case I took $h = 15$, about as far as it seemed worth while to go with only 40 serial correlations from which to construct the difference-correlations. The oscillations which are predominant when $h = 1$ are again, rather unexpectedly, conspicuous in this curve, the lowest on Fig. 20. On the other hand, the oscillations predominant in the second and third curves are more or less eliminated. The short oscillations are now too troublesome and the whole extent of our curve is too short to judge durations with any precision. If we may take the time to the point at which the curve first cuts the base as a half-duration—and it falls just about half-way between a maximum and a minimum of the minor oscillations, so that its position would not be greatly disturbed by them—this is roughly 13.5 years, suggesting an oscillation of duration 54 years, which is one of the periods noted by Sir William Beveridge, with an intensity 26.

The work may suffice to suggest the interesting way in which the serial correlations can be used to bring out, at least by a first rough analysis, the predominant characteristics of a given series. In the series in question there can be no doubt about the differences being oscillatory. I had some hopes that by making h sufficiently large

one would practically eliminate the effect of oscillations, but even with $h = 15$ the correlations are still conspicuously oscillatory. As emphasized, the mere fact that a series is oscillatory, as defined, is no evidence that it is periodic: but if it is periodic it must be oscillatory. In so far, then, the results are in accordance with Sir William Beveridge's periodogram analysis, and its indication that a considerable part of the price movement is periodic. Is there anything, on the other hand, which suggests that the movement is oscillatory rather than truly periodic? At first, inspection of the curves of Fig. 20 made me suspicious. The oscillations in the values of the correlations tend notably to decrease in amplitude as k is increased. This comes out clearly in the curves for $h = 1, 5$ and 6 , and it is exactly the sort of effect that may be obtained with a series which is oscillatory but not periodic. Further consideration showed me, however, that exactly the same effect will be given by the interference of different incommensurable periodicities. It is shown in Appendix I that if we have a function of the time expanded in a Fourier Series, so that

$$y = S \left\{ A_m \sin 2\pi \frac{t + \phi_m}{mT} \right\},$$

where $m = 1, \frac{1}{2}, \frac{1}{3} \dots$, the correlation between two ordinates of such a series at a time τ apart is given by

$$r = \frac{1}{S(A_m^2)} S \left\{ A_m^2 \cos 2\pi \frac{\tau}{mT} \right\}.$$

In the present instance we have not got a Fourier Series with its simple periodicities in the proportions $1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4} \dots$, but a whole collection of incommensurable periodicities. The serial correlations can now take no simple form when we sum over a finite time. But I think it will be true that if we sum over a very long time the inconvenient product-terms which occur in the summation will tend to become very small and that as a first approximation we may take a similar expression for r :—

$$r = \frac{1}{S(A_m^2)} S \left\{ A_m^2 \cos 2\pi \frac{\tau}{T_m} \right\};$$

It seemed to me that it might be illuminating to calculate such a curve for r and compare it with the figures obtained from the data. I chose the case $h = 5$ of Table XIV. I took out the periods (Table XV) which seemed likely to have any appreciable effect, from Sir William Beveridge's table on pp. 444-45 of his paper, together with their intensities. But here occurred the first difficulty—the intensities given are not, in the majority of cases, the true intensities, but those of neighbouring trial periods. There seemed

nothing for it but to take them as the true intensities. The next step was to calculate the correcting factors for these intensities, to allow for the fact that we have taken differences with an interval of 5 years; these are given in column 3 of Table XV. The intensities are then multiplied by these factors (column 4) and finally the products are divided by the sum of the intensities, so as to make the total sum unity (column 5). It will be noted that the effect of differencing on the original intensities is to make the predominant periodicities 15.225, 12.840, 17.400, 11.000, and 9.750, in the order given, the last three having almost equal intensities and the periodicities shorter than 12.84 having more importance than I had estimated from Fig. 20.

TABLE XV.—Calculation of the curve of Fig. 21 from certain of Sir William Beveridge's periods for wheat prices.

	(1) Period years.	(2) Intensity.	(3) Factor.	(4) Factor \times Intensity.	(5) Divided by sum of intensities.
1 ...	7.417	21.72	2.919	63.40	0.057
2 ...	8.050	23.23 +	3.448	80.10	0.072
3 ...	9.750	33.89	3.879	131.46	0.119
4 ...	11.000	33.84	3.919	132.62	0.120
5	12.050	23.30 +	3.721	86.70	0.078
6 ..	12.840	46.00 +	3.536	162.66	0.147
7 .	15.225	76.16 +	2.946	224.37	0.203
8 ..	17.400	54.12 +	2.465	133.41	0.120
9	19.900	37.88 +	2.016	76.37	0.069
10	35.5	23.29 +	0.735	17.12	0.015
Sum	—	—	—	1108.21	1.000

The compound cosine-curve with these intensities as amplitudes was now calculated, and the results are shown in Table XVI against the observed difference correlations; the graph is shown in Fig. 21. It will be seen that there is a broad, though only a broad, agreement with the data. There are only three discrepancies in sign, and the dying away of the oscillations is just as conspicuous in the calculated curve as in the data. The second "dip" is markedly double-humped, but the second minimum is markedly later than in the data and is deeper than the first. The agreement is, perhaps, as good as we have any right to expect, having used an approximate expression in the first place and approximate intensities in the second, and having ignored not only many other periodicities actually found in the data within the given range, but also all others outside it and all non-periodic components of the series.

TABLE XVI.—The ordinates of the compound harmonic curve derived from Table XV, compared with the observed coefficients in the column for $h = 5$ of Table XIV (cf. Fig. 21).

	Observed coefficient.	Calculated curve.		Observed coefficient.	Calculated curve.
0	+ 1.000	+ 1.000	18	— 0.133	— 0.007
1	+ 0.693	+ 0.862	19	— 0.182	— 0.063
2	+ 0.341	+ 0.496	20	— 0.196	— 0.062
3	+ 0.117	+ 0.033	21	— 0.162	— 0.028
4	— 0.127	— 0.360	22	— 0.131	+ 0.002
5	— 0.409	— 0.608	23	— 0.083	— 0.008
6	— 0.437	— 0.648	24	— 0.099	— 0.068
7	— 0.367	— 0.539	25	— 0.113	— 0.143
8	— 0.288	— 0.357	26	— 0.102	— 0.192
9	— 0.205	— 0.180	27	— 0.000	— 0.179
10	— 0.049	— 0.037	28	+ 0.033	— 0.102
11	+ 0.154	+ 0.066	29	+ 0.080	+ 0.004
12	+ 0.299	+ 0.153	30	+ 0.117	+ 0.095
13	+ 0.309	+ 0.222	31	+ 0.127	+ 0.132
14	+ 0.283	+ 0.261	32	+ 0.054	+ 0.113
15	+ 0.230	+ 0.252	33	+ 0.040	+ 0.064
16	+ 0.138	+ 0.190	34	+ 0.044	+ 0.023
17	— 0.013	+ 0.089	35	+ 0.018	+ 0.023

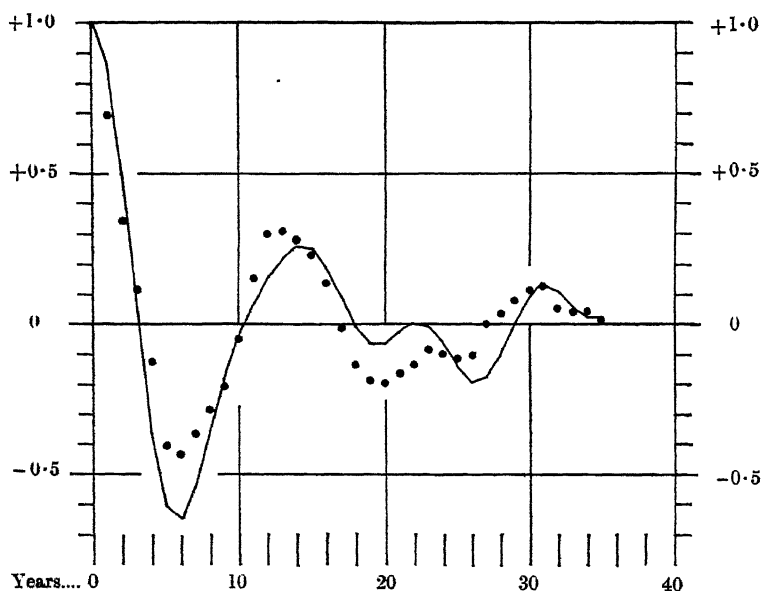


FIG. 21.—Serial difference correlations for $h = 5$ (Table XIV) (dots) and a curve constructed from certain of the periodicities given by Sir William Beveridge (line) (Table XVI).

Greenwich Rainfall.—The only other series which I have submitted to detailed analysis by this method is the rainfall at Greenwich over the 110 years 1815–1924. Records for a Continental station would have been better for comparison with the Beveridge Series, but this was the longest unbroken series that I could obtain.

Mere inspection of a graph suggests that the series is totally different in character from the last, and this impression is confirmed by the serial correlations given in Table XVII. All the correlations lie practically within the limits ± 0.2 , only one (r_{18}) just exceeding this value. Since the standard errors are all of the order 0.1, this would suggest that none of the correlations are significant, and that the series is practically random. But looking at the graph, Fig. 22, there are some slight suggestions of order. The correlations rise continuously over three years to the conspicuous maximum at r_7 . At first I had only calculated the serial correlations up to r_{10} , but this led me to continue the work up to r_{20} to see if there was a corresponding maximum at r_{14} . There is. And having got this, I was enticed to continue up to r_{24} to see if there was a maximum again at r_{21} ; it is a poor thing, but still a

TABLE XVII.—Serial correlations for Greenwich Rainfall, 1815–1924, and difference correlations for $h = 3$ and $h = 9$.

k .		r_k .	Δr_k .	$\Delta^2 r_k$.
1	....	— 0.0036	+ 0.093	+ 0.061
2	....	— 0.0594	— 0.011	— 0.093
3	....	+ 0.0459	— 0.466	+ 0.025
4	....	— 0.1248	— 0.099	— 0.114
5	....	— 0.0944	— 0.031	— 0.078
6	....	— 0.0182	— 0.014	— 0.033
7	....	+ 0.1858	+ 0.295	+ 0.280
8	....	— 0.0706	+ 0.032	— 0.072
9	....	— 0.0356	— 0.078	— 0.431
10	....	— 0.0658	— 0.211	— 0.036
11	....	— 0.1086	— 0.130	— 0.073
12	....	+ 0.0562	+ 0.095	+ 0.031
13	....	+ 0.0857	+ 0.208	+ 0.193
14	....	+ 0.1010	+ 0.155	+ 0.176
15	....	— 0.0133	+ 0.062	— 0.073
16	....	— 0.1597	— 0.185	—
17	....	+ 0.0149	— 0.035	—
18	....	— 0.2008	— 0.204	—
19	....	— 0.0521	+ 0.087	—
20	....	— 0.0036	+ 0.028	—
21	....	+ 0.0002	+ 0.029	—
22	....	— 0.1103	—	—
23	....	— 0.0756	—	—
24	....	+ 0.1462	—	—

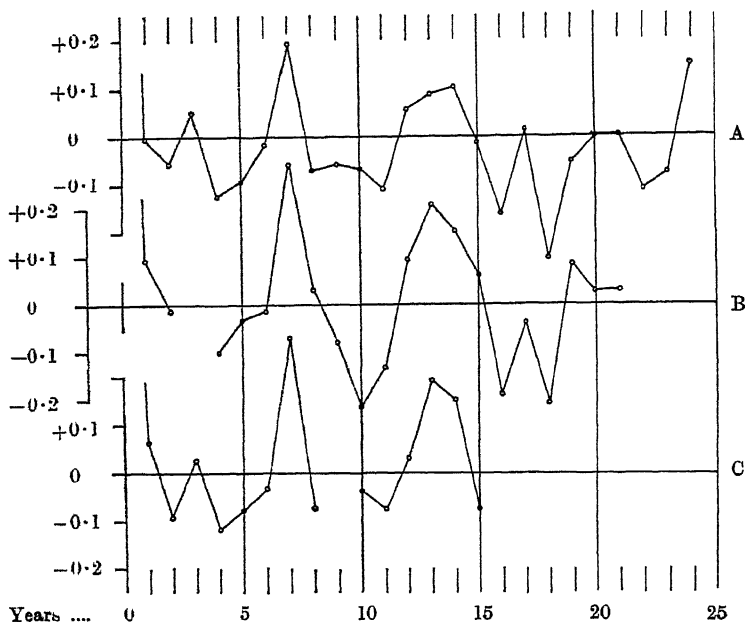


FIG. 22.—Serial correlations up to r_{24} for rainfall at Greenwich (Curve A): and difference correlations for $h = 3$ (Curve B), and for $h = 9$ (Curve C) (Table XVII).

maximum. This suggests a period—or an oscillation—of a duration close to 7 years. But there seems to be some interference by a shorter period, judging by the first maximum of about 3 years' duration. Taking difference correlations with $h = 3$ to eliminate this, the first thing that will be noted in the column for ${}_3\rho_k$ in Table XVII is the high negative correlation, -0.466 , for $k = 3$. This does not indicate any oscillation; it merely shows that the original series is nearly random, for if that series were purely random the correlation between consecutive first differences would be -0.5 .* I have therefore omitted the corresponding point from the graph, the second curve in Fig. 22. There is now a very marked maximum at 7, the second and third maxima lying at or just beyond 13 and 19. Taking the difference correlations for $h = 9$, and omitting for the same reason as before the point corresponding to ρ_9 , the graph is very similar, with the first conspicuous maximum at 7 and the

* In the difference correlations of Table XIV. ${}_6\rho_6$, ${}_{13}\rho_{11}$ and ${}_{15}\rho_{15}$ are minima, but the values seem to run well with the others, and do not suggest any large random component.

second about 13.5. There is little to suggest oscillations of long duration, which should have been brought out by such an interval of differencing. But a correlation of nearly 0.3 based on over 100 observations would seem to be probably significant, and I think there must be an oscillation present of about 7 years' duration, as the most conspicuous component, with possible oscillations of shorter duration in the neighbourhood of 3 years. But it remains true that something like 90 per cent. of the entire variance of the series appears to be random.

This concludes my work. Starting from a question that may have seemed to some silly and unnecessary, we were led to investigate the correlations between samples of two simple mathematical functions of the time. It appeared that small samples (in time) of such functions tended to give us correlations departing as far as possible from the truth, the correlations tending to approach ± 1 if the time for which we had experience was very small compared with the time necessary to give the true correlation. Asking ourselves, then, what types of statistical series might be expected to give results analogous to those given by the mathematical function considered, we were led to a classification of series by their serial correlations $r_1, r_2, r_3, \dots, r_k$, r_k being the correlation between terms s and $s + k$. The important matter in classification was the *form* of function relating r_k to k , which indicated the nature of the serial correlations between *differences* of the time-series. If this function is linear, the time-series has random differences; if it gives a graph concave downwards the difference correlations are positive. We concluded that it was series of the latter type (positively correlated series with positively correlated differences, or conjunct series with conjunct differences to use my suggested term) that formed the dangerous class of series, correlations between short samples tending towards unity. Experimental investigation completely confirmed this suggestion. Samples from conjunct series with random differences gave a widely dispersed distribution of correlations; samples from conjunct series with conjunct differences gave a completely U-shaped distribution, with over one-third of the correlations exceeding ± 0.9 . In the last section the method of analysis by serial correlations was illustrated by a couple of examples.

APPENDIX I.—*The correlation between segments of two sine-curves of the same period, etc.*

Two variables, y_1 and y_2 , are harmonic functions of the time t of the same period; say

$$\left. \begin{aligned} y_1 &= \sin 2\pi \frac{t}{T} \\ y_2 &= \sin 2\pi \frac{t+\tau}{T} \end{aligned} \right\} \quad (1)$$

where T is the period and τ the difference of phase; the amplitude is taken as unity since it does not affect the present question. It is required to find the correlation between simultaneous values of y_1 and y_2 over an interval $\pm h$ round the time u , treating the observed values as continuous. Taking the second variable, as giving the general result from which that for y_1 may be deduced by putting $\tau = 0$, we have

$$\begin{aligned} \int_{u-h}^{u+h} \sin 2\pi \frac{t+\tau}{T} dt &= \frac{T}{2\pi} \left\{ \cos 2\pi \frac{u+\tau-h}{T} - \cos 2\pi \frac{u+\tau+h}{T} \right\} \\ &= \frac{T}{\pi} \sin 2\pi \frac{u+\tau}{T} \sin 2\pi \frac{h}{T}, \end{aligned}$$

or, dividing by $2h$, we have for the mean of y_2 over the interval,

$$M_2 = \frac{T}{2\pi h} \sin 2\pi \frac{u+\tau}{T} \sin 2\pi \frac{h}{T}. \quad (2)$$

Further,

$$\int_{u-h}^{u+h} \sin^2 2\pi \frac{t+\tau}{T} dt = h - \frac{T}{4\pi} \cos 4\pi \frac{u+\tau}{T} \sin 4\pi \frac{h}{T},$$

or, dividing by $2h$,

$$\Sigma_2^2 = \sigma_2^2 + M_2^2 = \frac{1}{2} - \frac{T}{8\pi h} \cos 4\pi \frac{u+\tau}{T} \sin 4\pi \frac{h}{T} \quad (3)$$

where σ_2 is the standard deviation of y_2 over the interval.

To find the mean product p' of y_1 and y_2 over the interval, we require

$$\begin{aligned} \int_{u-h}^{u+h} \sin 2\pi \frac{t}{T} \sin 2\pi \frac{t+\tau}{T} dt \\ = h \cos 2\pi \frac{\tau}{T} - \frac{T}{4\pi} \cos 2\pi \frac{2u+\tau}{T} \sin 4\pi \frac{h}{T}, \end{aligned}$$

or

$$p' = \frac{1}{2} \cos 2\pi \frac{\tau}{T} - \frac{T}{8\pi h} \cos 2\pi \frac{2u+\tau}{T} \sin 4\pi \frac{h}{T}. \quad (4)$$

Equations (2), (3) and (4) suffice for the arithmetical solution of the problem. It does not seem possible to simplify the equations sufficiently to obtain any manageable expression for the correlation-coefficient r as a function of u , h and τ . But from (2) we can calculate, in any assigned case, the means M_1 and M_2 ; (3) will then give the standard deviations, and (4) will give the mean product of deviations p by subtracting the product M_1M_2 .

The most interesting case, dealt with at length in Section II of the paper, is given by taking $\tau/T = \frac{1}{2}$, when the correlation between y_1 and y_2 over a whole period is obviously zero. For this case

$$\left. \begin{aligned} M_1 &= \frac{T}{2\pi h} \sin 2\pi \frac{u}{T} \sin 2\pi \frac{h}{T} \\ M_2 &= \frac{T}{2\pi h} \cos 2\pi \frac{u}{T} \sin 2\pi \frac{h}{T} \\ \Sigma_1^2 &= \frac{1}{2} - \frac{T}{8\pi h} \cos 4\pi \frac{u}{T} \sin 4\pi \frac{h}{T} \\ \Sigma_2^2 &= \frac{1}{2} + \frac{T}{8\pi h} \cos 4\pi \frac{u}{T} \sin 4\pi \frac{h}{T} \\ p' &= \frac{T}{8\pi h} \sin 4\pi \frac{u}{T} \sin 4\pi \frac{h}{T} \end{aligned} \right\} \quad (5)$$

From these equations the curves showing r as a function of u were drawn (Fig. 4) for values of $2h/T$ equal to 0.1, 0.3, 0.5, 0.7 and 0.9. Since the period of the r -curve is half that of the y -curve, it is not necessary to carry the calculations beyond $u/T = \frac{1}{2}$, i.e., 45° . The values of r were usually calculated at every 5° , with supplementary values at 1° or 2.5° over the range from 0° to 15° .

Finally, to obtain from these calculations the frequency-distribution of r , on the assumption that u is equally likely to fall at any point of the range between 0 and T , the values of u/T for which $r = 0.1, 0.2, \dots 0.9, 0.91, 0.92 \dots$ up to the maximum, were found by the use of the second difference interpolation-formula equation (4) on p. xiv of *Tables for Statisticians and Biometricians*. If k_1, k_2 are the values of u/T corresponding to the values r_1, r_2 of r , $k_2 - k_1$ measures the frequency of values of r between these limits. The interpolation-formula referred to did not give results of any great precision, for the intervals chosen, at some parts of the range, but no more accuracy was desired than sufficed to draw the rough charts (Figs. 5—9).

Taken over a whole period, $2h = T$ and

$$\begin{aligned} M_1 &= M_2 = 0, \\ \sigma_1^2 &= \sigma_2^2 = 0.5, \\ p' &= p = \frac{1}{2} \cos 2\pi \frac{\tau}{T}. \end{aligned}$$

Hence

$$r = \cos 2\pi \frac{\tau}{T}, \quad (6)$$

a formula which holds good also, it may be noted, if we do not treat variation as continuous, but are given only ordinates at equal intervals throughout the period. If τ/T is $\frac{1}{6}$, or $2\pi\tau/T$ is 60° , $r = 0.5$, and this is the second case taken for illustration. The interval $2h/T$ chosen was 0.2. For this case the equations for means, etc., become, converting the angle into degrees and writing for brevity,

$$\theta = 360u/T;$$

and taking this angle in degrees:—

$$\left. \begin{aligned} M_1 &= 0.935\,4893 \sin \theta \\ M_2 &= 0.935\,4893 \sin (\theta + 60) \\ \Sigma_1^2 &= 0.5 - 0.378\,41335 \cos 2\theta \\ \Sigma_2^2 &= 0.5 - 0.378\,41335 \cos 2(\theta + 60) \\ p' &= 0.25 - 0.378\,41335 \cos (2\theta + 60) \end{aligned} \right\} \quad (7)$$

The curve for r as a function of u is not shown, but the frequency-distribution is given in Fig. 10.

Referring back to equation (6), we may obtain a general expression that is utilized in Section V. Suppose we have some function expanded in a Fourier Series, the time T being the fundamental period, so that—omitting the constant term which will not affect any correlations—

$$y_1 = S \left\{ A_m \sin 2\pi \frac{t + \phi_m}{mT} \right\} \quad (8)$$

where $m = 1, \frac{1}{2}, \frac{1}{3}, \dots$. Then integrating over time T ,

$$\sigma_1^2 = \frac{1}{2} S (A_m^2), \quad (9)$$

the products of terms of unlike period vanishing. If we take the same function shifted in phase by the amount τ so that

$$y_2 = S \left\{ A_m \sin 2\pi \frac{t + \tau + \phi_m}{mT} \right\}, \quad (10)$$

the mean product is

$$p = \frac{1}{2} S \left\{ A_m^2 \cos 2\pi \frac{\tau}{mT} \right\}. \quad (11)$$

The standard deviation is, of course, the same as before, and hence

$$r = \frac{1}{S(A_m^2)} S \left\{ A_m^2 \cos 2\pi \frac{\tau}{mT} \right\}. \quad (12)$$

Plotted to τ as base, the curve for r is compounded of cosine curves of the original periods, all shifted into phase at $\tau = 0$, with *intensities* substituted for their amplitudes.

APPENDIX II.—*The relations between the serial correlations of a sum series and of its difference series, when the series may be regarded as indefinitely long.*

THE DIRECT PROBLEM.—Let $u_0, u_1, u_2, u_3, \dots, u_s, \dots, u_m$ be a series for which the serial correlations are $r_1, r_2, r_3, \dots, r_k, r_k$ being the correlation between u_s and u_{s+k} . Let σ_u be the standard deviation of the u 's. Then

$$\Sigma (u_{s+1} - u_s)^2 = \Sigma (u_{s+1})^2 + \Sigma (u_s^2) - 2\Sigma (u_{s+1} u_s).$$

The sum on the left is extended over all first differences. Hence on the right the first sum only covers u_1 to u_m , where u_m is the last in the series, and the second only u_0 to u_{m-1} : we shall suppose the series to be so long that means and standard deviations are not sensibly affected by this dropping of initial and terminal observations. On this assumption, reading the u 's as deviations, we have

$$\sigma_s^2 = 2\sigma_u^2 (1 - r_1). \quad (1)$$

Next, to determine the correlation between adjacent first differences, we have

$$\begin{aligned} \Sigma (u_{s+2} - u_{s+1})(u_{s+1} - u_s) \\ = \Sigma (u_{s+2} u_{s+1}) + \Sigma (u_{s+1} u_s) - \Sigma (u_{s+2} u_s) - \Sigma (u_{s+1}^2). \end{aligned}$$

On the same assumption as before, both the first and the second terms on the right may be written $Nr_1\sigma_u^2$, the third $Nr_2\sigma_u^2$, and the last $N\sigma_u^2$. Hence by (1), using ρ 's for the serial correlations of the difference series,

$$\rho_1 = \frac{2r_1 - r_2 - 1}{2(1 - r_1)}. \quad (2)$$

Proceeding in precisely the same way, we have generally

$$\rho_k = \frac{2r_k - r_{k+1} - r_{k-1}}{2(1 - r_1)}, \quad (3)$$

which checks with (2), noting that $r_0 = 1$. But this may evidently be written

$$\rho_k = -\frac{1}{2(1 - r_1)} \Delta^2(r_{k-1}). \quad (4)$$

This gives the most convenient method of working out the limiting difference correlations when the serial correlations for the u 's are given: the second differences of the series $1, r_1, r_2, r_3 \dots$ are formed, and multiplied though by $1/2(1 - r_1)$, reversing signs. Note also that if the ρ 's are positive, the graph of the r 's must be concave downwards, as in Fig. 12 of the paper; if the ρ 's are negative, the graph of the r 's must be concave upwards; and, finally, if the ρ 's are zero, the graph of the r 's must be a straight line, as in Fig. 11 of the paper.

Suppose that the first differences are formed with the interval h instead of the interval unity, *i.e.*, the differences are taken as

$$\begin{array}{c} u_h - u_0 \\ u_{h+1} - u_1 \\ u_{h+2} - u_2 \\ \dots \dots \dots \\ u_{h+k} - u_k. \end{array}$$

Then by similar reasoning we have

$$h\rho_k = \frac{2r_k - r_{k+h} - r_{k-h}}{2(1 - r_h)}. \quad (5)$$

Putting $h = 1$, this becomes identical with (3). Where $k < h$, remember that $r_{k-h} = r_{h-k}$.

THE INVERSE PROBLEM.—Now consider the inverse problem: given the ρ 's for the difference series, required to find out what we can about the r 's for the sum series. We will consider only certain special cases.

A.—*The differences are random*, so that all ρ 's are zero. We then have

$$\Delta^2 r_{k-1} = 0 \quad (6)$$

for all values of k . It is obvious that the r 's must form an arithmetic

series, but the series is not determinate unless one term, say r_1 , is given. The series is then 1, r_1 , $2r_1 - 1$, $3r_1 - 2$, etc., or generally

$$r_k = k r_1 - (k - 1). \quad (7)$$

In any actual case the r_k 's will not, of course, form a strictly arithmetical series, owing partly to the inevitable chances of sampling and partly to the "end-effects," and consequently a "best fitting" series will have to be determined by assigning some special value, say r_1' , to r_1 . The readiest, and on the whole the best, method to determine r_1' seems to be to make the sum of the calculated correlations equal to the sum of those observed, so that the mean error is zero. This gives

$$\frac{1}{2}k(k+1) r_1' = \frac{1}{2}k(k-1) + \Sigma(r_k), \quad (8)$$

or for the special case when k is 10,

$$11 r_1' = 9 + 0.2 \Sigma(r_k). \quad (9)$$

Fitting by least squares offers no difficulty, but does not make the mean error zero and does not seem, in the cases tried, at all markedly to reduce the errors.

I worked out r_1 to r_{10} for my first three series with random differences (A_1 , B_1 , and C_1) each of 100 terms. The original correlations were taken to five figures, and r_1' was calculated from these. Table A shows the observed correlations against the fitted series to three digits. For A_1 and C_1 the fit seems very satisfactory; for B_1 it is poor. Fig. 11 of the paper (p. 24) shows the results. It is odd that all the series give positive errors (r in excess of the calculated values) in the later terms. Is this due in some way to the end-effect, or is it merely chance? The next case does not show the same thing.

TABLE A.—Comparison of serial correlations for three series with random differences, with fitted arithmetical progressions.

	Series A_1 .		Series B_1 .		Series C_1 .	
	Observed correlation.	Calculated series.	Observed correlation.	Calculated series.	Observed correlation.	Calculated series.
1	0.963	0.976	0.882	0.921	0.954	0.950
2	0.934	0.951	0.792	0.843	0.900	0.900
3	0.911	0.927	0.705	0.764	0.842	0.850
4	0.889	0.903	0.626	0.686	0.780	0.800
5	0.879	0.878	0.587	0.607	0.729	0.750
6	0.859	0.854	0.525	0.528	0.689	0.700
7	0.836	0.829	0.513	0.450	0.654	0.650
8	0.817	0.805	0.455	0.371	0.613	0.600
9	0.797	0.781	0.350	0.292	0.571	0.550
10	0.776	0.756	0.242	0.214	0.519	0.500

But these figures and the chart of Fig. 11 will perhaps, and legitimately, raise a difficulty in the mind of the reader. If the lines are continued downwards, they will lead first to negative and then to impossible values of the correlation. Any line with a finite slope must give the same trouble if continued sufficiently far. But the point is that we can only obtain such series as those of Table A if the serial correlations are determined from a *finite* series, and for a finite series (6) will be only approximately true for moderate values of k and will cease to be valid for large values. As the u -series is extended indefinitely, σ_u tends to increase indefinitely: but ${}_h\sigma_\delta$ —the standard deviation of first differences with an interval h —remains finite for all finite values of h . Hence, since

$${}_h\sigma_\delta^2 = 2\sigma_u^2 (1 - r_h),$$

r_h must tend to unity for all finite values of h . For an indefinitely long series of the type considered all the serial correlations tend to unity.

B.—*The differences are correlated.* ρ_k being a linear function of k . Since ρ_0 must be unity, we may take

$$\rho_k = 1 - \alpha k. \quad (10)$$

Hence

$$\Delta^2(r_{k-1}) = -2(1 - r_1)(1 - \alpha k) \quad (11)$$

Since the second differences are a linear function of k , the series $r_0, r_1, r_2, \dots, r_k$ must evidently be a polynomial in k involving powers up to the third, say,

$$r_k = 1 + bk + ck^2 + dk^3. \quad (12)$$

Here

$$\Delta^2(r_{k-1}) = 2(c + 3dk), \quad (13)$$

and hence, equating coefficients

$$\left. \begin{aligned} c &= -(1 - r_1) \\ d &= \frac{1}{3}\alpha(1 - r_1) \end{aligned} \right\} \quad (14)$$

Inserting these values in (12) and putting $k = 1$, we have

$$b = -\frac{1}{3}\alpha(1 - r_1) = -d. \quad (15)$$

Hence finally, writing for brevity

$$1 - r_1 = m, \quad (16)$$

we have

$$r_k = 1 - mk^2 + \frac{1}{3}\alpha mk(k^2 - 1) \quad (17)$$

For the special case of correlated differences in the experiments of Section IV, $\alpha = \frac{1}{11}$. If we determine the "best" value of m , say, m' , by making the sum of the observed values of r_s from $s = 1$ to $s = k$ equal to the sum of the values calculated from (17), we have as the general equation for determining m' .

$$\sum_0^k (r_s) = k - m' \left\{ \frac{1}{6}k(k+1)(2k+1) + \frac{1}{6}\alpha k(k+1) - \frac{1}{12}\alpha k^2(k+1)^2 \right\} \quad (18)$$

which, for $k = 10$ and $\alpha = \frac{1}{11}$, reduces to

$$295m' = 10 - \sum (r_s). \quad (19)$$

The first ten serial correlations for the experimental series A_2 , B_2 , C_2 were calculated in the original work to five figures. Table B shows these observed values to three figures against the series (17) fitted by equation (19). For series A_2 and C_2 the fit is excellent: B_2 , like B_1 , is rather more irregular. Graphs are shown in Fig. 12. p. 25.

TABLE B.—Comparison of serial correlations for three series with correlated differences, with fitted cubic series.

	Series A_2		Series B_2		Series C_2	
	Observed correlation.	Calculated series.	Observed correlation.	Calculated series.	Observed correlation.	Calculated series.
1	0.999	0.999	0.991	0.991	0.996	0.996
2	0.995	0.995	0.966	0.965	0.986	0.985
3	0.990	0.989	0.927	0.923	0.968	0.968
4	0.982	0.982	0.876	0.868	0.945	0.945
5	0.973	0.972	0.814	0.802	0.916	0.918
6	0.963	0.962	0.741	0.725	0.883	0.886
7	0.951	0.950	0.654	0.640	0.848	0.851
8	0.937	0.937	0.552	0.548	0.811	0.813
9	0.922	0.924	0.436	0.451	0.774	0.773
10 ...	0.906	0.910	0.307	0.351	0.738	0.731

We have only worked out the calculated series up to r_{10} . Since $\Delta^2(r_{10})$ is zero, the series beyond this point becomes linear.

For this type of series, as for the last, serial correlations such as are shown in Table B are only possible for a finite series. For an infinite series, all serial correlations would tend to unity.

C.—*The second differences of the given series are random, i.e., the given series is the second sum of a random series.*

In this case the first differences of the given series are the sum

of a random series, and therefore the serial correlations of the differences are given by equation (7), or, writing this in the form of (10),

$$\rho_k = 1 - k(1 - \rho_1), \quad (20)$$

so that the α of equation (10) is $1 - \rho_1$. The r -series is consequently given by (17).

So far as samples of no more than 10 observations are concerned, the special mode of forming the series used for the experiments on series with correlated differences leads therefore to precisely the same results as regards the frequency-distribution of correlations, as would the second summation of a random series. This conclusion was utilized in Section III of the paper.

The actual mode of formation used was to sum successive batches of 11 terms of the random series and then use these as differences. If $a_1, a_2, a_3 \dots a_3$ is the random series, $u_1, u_2, u_3 \dots u_3$ the final series,

$$\begin{aligned} \Delta^1(u_1) &= a_1 + a_2 + \dots + a_{11} \\ \Delta^1(u_2) &= a_2 + a_3 + \dots + a_{12} \\ &\dots \dots \dots \\ \Delta^1(u_{10}) &= a_{10} + a_{11} + \dots + a_{20}, \end{aligned}$$

and therefore

$$\begin{aligned} \Delta^2(u_1) &= a_{12} - a_1 \\ \Delta^2(u_2) &= a_{13} - a_2 \\ &\dots \dots \dots \\ \Delta^2(u_{10}) &= a_{21} - a_{10}. \end{aligned}$$

Within the sample of 10 terms only, second differences *are* uncorrelated. Not until we reach $\Delta^2(u_{12})$ would there be a negative correlation with $\Delta^2(u_1)$.

D.—*A special case of causation.*—Let us now, instead of assuming a special form for the serial correlations, assume a special mechanism of causation and ask to what serial correlations it leads.

It is familiar that if we take a set of dice of which n_1 are red, n_2 white and n_3 green, the correlation between the number of successes in the red and white together and the number of successes in the white and green together is $n_2/(n_1 + n_3)$ or the proportion of dice common to the two sets. Now suppose that the magnitude of our variable in any year is determined by a number of independent, unitary, elementary causes (analogous to the dice), and that n_1 of these causes come into existence in every successive year, of which pn_1 survive to the next year only, p^2n_1 for two years, and so

on. The total number of causes operating in any one year will then be

$$\begin{aligned} n &= n_1 (1 + p + p^2 + p^3 + \dots) \\ &= n_1 / (1 - p), \end{aligned} \quad (21)$$

and a proportion p of these will be common to years s and $s + 1$, p^2 to years s and $s + 2$, and so on. The serial correlations will therefore be $1, p, p^2, p^3, \dots$. As the graph of this geometric series is concave upwards, we have the rather unexpected result that for this type of continuity of causation the serial correlations for the differences must be *negative*. We have, in fact,

$$\rho_k = -\frac{1}{2}(1 - p)p^{k-1}. \quad (22)$$

The difference correlations, from ρ_1 onwards, are a geometric series of negative sign.

It is of interest to ask now a further question. Supposing that such a system of causation as we have assumed determines, not the *values* of the variable, but its *changes* from year to year, i.e., the first differences, what will be the serial correlations for the sum series?

We have now

$$\Delta^2 (r_{k-1}) = -2(1 - r_1) \rho^k, \quad (23)$$

and the general solution is of the form

$$r_k = A - Bk + Ce^{-bk}. \quad (24)$$

Hence

$$\Delta^2 (r_{k-1}) = Ce^{-b} (e^b - 1)^2 e^{-bk} = -2(1 - r_1) \rho^k.$$

We must therefore have

$$e^{-b} = \rho, \quad (25)$$

and thence, writing for brevity, $1 - r_1 = m$ as before,

$$C = -\frac{2m\rho}{(1 - \rho)^2}. \quad (26)$$

Further, for $k = 0$, $r_k = 1$, and therefore

$$A = 1 - C. \quad (27)$$

Whence

$$r_1 = 1 + \frac{2m\rho}{(1 - \rho)^2} - B - \frac{2m\rho^2}{(1 - \rho)^2},$$

or

$$B = m \frac{1 + \rho}{1 - \rho}. \quad (28)$$

Therefore, finally, (24) becomes

$$r_k = 1 - m \frac{1 + \rho}{1 - \rho} k + \frac{2m\rho}{(1 - \rho)^2} (1 - \rho^k). \quad (29)$$

Table C shows two calculated series : ρ is taken at 0.95 in both cases, but r_1 is taken at the respective values shown. The graphs are not very unlike the cubics of Fig. 12 : it is left to the reader to draw them if he desires.

TABLE C.—Serial correlations for two series in which the serial correlations for differences form a (positive) geometric series.

				Case 1.	Case 2.
1	...	....		0.99	0.995
2	....	....		0.961	0.9805
3	....	....		0.91395	0.95697
4	....	....		0.84975	0.92488
5	...	....		0.76927	0.88463
6	...	....		0.67330	0.83665
7	....	...		0.56264	0.78132
8	....	....		0.43800	0.71900
9	....	....		0.30010	0.65005
10	....	....		0.14960	0.57480

PROCEEDINGS OF THE MEETING.

PROFESSOR EDGEWORTH : Mr. President, I have great pleasure in proposing a vote of thanks to you. You have made a most important contribution to a study in which we all should be engaged—the logic of statistics. We have outgrown the too modest aims of our founders, who adopted a motto implying that we were only to collect facts, leaving it to others to grind the grain which we had collected. Now we see that our President not only collects copious harvests with the sickles of observation and experiment, but he also himself grinds the grain, and serves it up to us as a food for thought which is most nutritious, although perhaps a little difficult of mastication. I will not attempt to bite off more than I can chew within the short period of my address. I shall confine myself to the simplest exemplification of his deep theories.

Let us consider two phenomena of the kind which he has represented, say, church marriages and mortality. Let us begin with the supposition that the graphs which represent the variation of the two quantities, say, y_1 and y_2 , are the simplest possible—say, straight lines. By a suitable choice of units, the two lines may be made to coincide. It would be as if in Fig. 1 the full black line coincided with a line joining the successive little circles. Now, let us vary the construction, and, as usual in dealing with problems of correlation, represent the two magnitudes under consideration by x and y respectively. Then the time might be denoted by an ordinate z perpendicular to the plane of (x, y) . On the suppositions made, the variation of x with the time would be represented by a straight line in the plane of (x, z) ; and there would be a corresponding line

in the plane of y_2 representing the course of y . The dots in the plane of (x, y) representing each a concurrence of two particular values of those variables, would move continuously in a straight line. They would not behave as the dots which are presented by statistics fulfilling the two-dimensional law of error: say, the heights of father and son. In that case, the dots which occur as we pass from one family to another do not keep together, but jump in random fashion from one quadrant to another: say, from the quadrant $(+x, +y)$ to the quadrant $(-x, -y)$, or even occasionally to one of the two other quadrants. Much the same would be true, for a time at least, over a certain range of values for x and y , if we substitute for straight lines curves with a small curvature; or, indeed, any ordinary geometrical figure. But, of course, the graphs representing statistical frequency are not in general ordinary geometrical figures. Nevertheless, they may have this in common with curves which are represented by a mathematical function, that there is some interdependence between different portions of the figure, a more or less definite connection between successive elements. I will not follow the President into the depths of the subject; suffice it that we emerge with the presumption that the sort of insignificant appearance of correlation which he has pointed out is by no means uncommon.

Here I would like to ask the President whether we might not extend the peculiarities which he has investigated to other categories besides time? What about space? Are there not nonsense-correlations in space? Some statistics collected by Hain suggest that as we move across Europe in a south-westerly direction we find the proportion of male to female births to increase continuously; in England, for instance, the proportion is particularly small, in Greece particularly large. Say that as we move in the said direction alcoholic indulgence is found to diminish. Would not this be a "nonsense-correlation"? This consideration suggests that there may be other categories besides space and time that present in coherence a number of phenomena which seem to have no common cause, no connection except through a word—"civilization" or "evolution."

If the mathematical method of correlation is so deceptive, shall we fare better by confining ourselves to the more ordinary methods of statistics, as recommended by Professor Westergaard? * He must not be understood as referring to cases in which the two-dimensional normal law of error is known to be fulfilled, *e.g.*, in some biometric statistics where the use and beauty of Galton's theory is manifest. He seems rather to have in view the interdependence of social phenomena, such as in the example given by him of the connection between voting against female suffrage and voting against liquor legislation. To investigate interdependence in such cases he would proceed as follows: He would arrange one set of data, *e.g.*, the mortalities in our example, in the order of magnitude,

* See *Journal of the Royal Statistical Society*, vol. lxxxii.

and divide them into several groups, each group represented by a segment of the abscissa x . Corresponding to each element of x he would observe the average magnitude of the other phenomenon, y , *e.g.*, proportion of church marriages. If y is found continually to increase (or diminish) with x , we may presume that there is a connection between the phenomena.

But we have still no guarantee that the apparent connection is significant. In fact, there is available only what Mill calls the Method of Concomitant Variations; which, as he observes, is not adequate to prove causation. For instance, we should not advise our young friends to abstain from marriage in church in order to prolong their lives. As a remedy for the characteristic defect of Concomitant Variation, Mill recommends the use of his Method of Difference. This method presents peculiar difficulties where one phenomenon is ever presented in company with the other. This peculiarity, perhaps, accounts for the President's feeling that the "nonsense-correlation" occurring in a "time-series" are particularly serious.

It should be observed that even for the Method of Difference there is required some prior judgment as to what circumstances are (in Mill's phrase) "material"; what differences—*e.g.*, in the position of the star, with respect to social phenomena—may be treated as indifferent. No logical instrument, whether or not sharpened by mathematics, is proof against fallacy. Behind the tool, however perfect, there is required a capable man. We are fortunate in having a President who not only constructs new tools, but knows how to use them.

Dr. GREENWOOD said he had overcome the gentle melancholy with which he was filled on being asked by the Council to second the vote of thanks. The melancholy arose in the following way. A surgeon friend told him that the President of the College of Physicians met him in the street and said: "I am sorry to see you are getting middle-aged." The surgeon replied: "How is this? I am feeling quite well." "Well," replied the President of the College of Physicians, "I see you have been elected a Vice-President of the Medical Society." In the same way Dr. Greenwood had a feeling of middle-age in being invited to second the vote of thanks for the Presidential Address, but he had been comforted by two circumstances—that by the processes of some psychological infection he might acquire the secret of perpetual youth from Professor Edgeworth, and also that speaking on the Address gave him the opportunity of dealing with aspects of the President's work not relevant to an ordinary discussion.

Dr. Greenwood reminded the President that in his first Presidential Address he had expressed the fear that he had been one of the culprits in rendering the statistics of the Society more technical, and had put forward the defence that without improvement in technique statistical science could not advance. Dr. Greenwood

thought all would agree that no defence was needed, the facts had to be faced, that statistics were going to become more mathematical every day.

In his interesting text-book, Mr. R. A. Fisher had recently defined statistics as a branch of applied mathematics, and Dr. Greenwood had a dismal feeling that that was true; if it were true it was exceedingly important that the mathematics of statistics should be dealt with in an intelligible way. The men who had made possible great advances in statistical theory in the remoter past were nearly all persons whose primary interests were mathematical; they were first mathematicians, and only last—if at all—statisticians. The difficulty of mathematics felt by all was that mathematics, perhaps more than any other intellectual discipline, required a natural aptitude for successful cultivation. Although *that* difficulty of mathematics was no doubt the most prominent one, Dr. Greenwood thought it was a mistake to suppose that it was the whole difficulty of mathematical investigation. In addition, there was the question of acquired knowledge, and the fact that some of the difficulties experienced in the mathematical treatment of statistical problems had been due to the use of mathematical results, the comprehension of which depended upon much previously acquired knowledge. There were departments of mathematics in which the logical difficulty of following the train of reasoning might really be no greater than that involved in following the logical train of reasoning in elementary algebra, but the premises implied a knowledge of theorems, which all but scholarly mathematicians had to take purely on trust, with the inevitable tendency that deductions satisfactory to a highly trained mathematician might be unsatisfactory to a reader who was unacquainted with the theorems assumed to be known. It was a happy circumstance that much important mathematical statistical work of recent years, work expressed in strict mathematical terminology, in language that required a very close application to follow, did not make heavy demands on the previous mathematical acquirements of the reader.

Dr. Greenwood referred to the work of the Society's distinguished Honorary Fellow, Professor Tschuprow, as an example of strict mathematical reasoning, difficult to follow indeed but intrinsically difficult, not *impossible* to understand without wide mathematical knowledge. He also referred to the work of Mr. H. E. Soper on Frequency Arrays as a brilliant example of the same class. Highly important results, deduced originally by their discoverers in mathematical language, hardly intelligible without previous knowledge of many branches of mathematics, were reached by Mr. Soper by a strict method of reasoning which required application to follow, but did not depend upon a store of known theorems. All who had studied the question would agree that the Society's President was a most distinguished member of the band of mathematical statisticians in this country who had followed that route. In all the important contributions that he had made to the technical side of statistical

processes. although in many cases the work itself was difficult to follow—it required constant attention to follow the steps of the reasoning—yet the difficulties were in all cases intrinsic, not extrinsic, difficulties, and in the Address just delivered the President had carried out his customary procedure.

Even if it were customary to discuss a Presidential Address, it would clearly be unreasonable to discuss the details of this work in a short time, but it certainly presented these general characters. Some of the steps required close application to follow, but they could be followed by anyone who would take pains to do so, and without a large acquired knowledge of theorems and results in the various departments of pure mathematics.

In Dr. Greenwood's view, if statistics were to progress and become a great intellectual discipline, it was very important that mathematical writers should in fact follow the path trodden by the President—that was to say, that when there were two ways of reaching a particular result, or investigating a particular problem, the method that started with a less assumption of acquired mathematical knowledge should invariably be adopted, even if it were less "elegant" and more laborious.

There was, perhaps, just a touch of vanity in the predilection of the learned for reaching a result by a reference to some particular theorem in a special branch of mathematics; it must sometimes be due to the same instinct which prompted people to quote Latin when the thought expressed could be equally well, or perhaps even better, expressed in English. It seemed to Dr. Greenwood that it was a very happy augury for the future that the President of the Royal Statistical Society should be investigating an important mathematical statistical problem, and be using mathematical methods based upon simple principles of reasoning, and illustrated at every step by an experiment.

The practical problem involved in the paper was of particular importance to all concerned with medical statistics, because of the tendency to infer conclusions from the apparent concurrence of time-series, and the only method at all widely used—that of fitting polynomials to the two trends and taking the deviations from these loci as the basis of study—involved considerable difficulties of interpretation. Although the work probably would not, and could not, command complete acceptance at once, it was a valuable contribution, not merely to the general theory of statistics, but to the practice of a very important branch of applied statistics.

Dr. Greenwood had the greatest pleasure in seconding the vote of thanks to the President.

Mr. G. UDNY YULE said he was very grateful to the members of the Society for the way in which they had received his Address, and to the proposer and seconder of the vote of thanks for the kind things they had said. He did not think he had any solid criticisms to which to reply. The point under discussion was one that had

both puzzled and interested him for a long time, and it was a point of practical importance, as many arguments had been put forward on a basis that seemed hardly more serious than his Fig. 1. In the paper he had endeavoured to bring the whole question into relation with general notions of sampling. The result showed that in many cases one must simply confess inability to prove a real secular correlation between two time variables, and yet the difficulty remained that one did sometimes want to show whether or not there was such a correlation.

But it might be sometimes possible to get round the difficulty in some way or other. The problem arose, for example, in his last Presidential Address, where his work suggested a secular correlation between the birth-rate and death-rate. He got round the difficulty there by showing that there were correlations between the changes in the birth-rate and death-rate over a long interval of time—say, a period of thirty years—when taking all the different countries of Europe together. In other cases there might possibly be some such way of testing a theory without a mere comparison of graphs, whether by correlation or otherwise, which would lead to a fallacious interpretation.

Mr. Yule apologized for giving an Address which was exceedingly technical, and which might frighten some candidates from joining the Society. At the same time, the number of candidates for election at the meeting was distinctly encouraging, the number being no less than 33, and Mr. Yule was glad to be able to announce that they had all been duly elected to the Fellowship of the Society.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society:—

Frances Fenton Bernard.	Vellore Zoganatha Mudaliar.
Stephen Brainerd Blake.	Arnold Edersheim Overton
Charles John Nelson Borg.	Arthur Redford
Victor Harold Burraston.	Alan Blackwood Ritchie.
Harold Cox	Dansie Thomas Sawkins, M A ,
Winifred Adeline Elkin.	B.A.
Clarence Fleetwood.	Felix Ira Shaffner, M.A.
Ronald Frank George.	Dr. Labib Shehata.
Edward Thomas Newcomen (Grove	Arnold Nixon Shimmin
David Gurevich, Ph D , M A ,	Percy Stocks, M A , M D., D.P.H.
B Sc.	Douglas Argyll Tatham-Thompson.
Frank Herbert	Frederick William Thomas.
Thomas William Hodkin.	Victor Walton.
Lakshmi Chandra Jain, M A.,	Hugh Thomas Weeks.
J.L.B.	Frank M. Weida.
Frank Lidgett McDougall.	Eugene Robert Woodson.
Jules Menken.	

Corporate Representatives.

Dr. J. V. De Porto, *representing* the New York State Department of Health.
 David Kemp, M A , *representing* the British Engineers Association
 (Incorporated)
 Robert Henry Scanes Spicer, *representing* the Engineering and Allied
 Employers' National Federation.

THE INTERNATIONAL STATISTICAL INSTITUTE AND ITS
SIXTEENTH SESSION.

By SIR HENRY REW, K.C.B.

[Read before the Royal Statistical Society, December 15, 1925, the President,
Mr. G. UDNY YULE, F.R.S., in the Chair.]

THE progress and proceedings of the International Statistical Institute have always had especial interest for the Royal Statistical Society, which, indeed, may claim, if not the rights of parentage, at any rate the distinction of assisting at the birth. Indeed, the relationship of the Society to the Institute may almost be described as grandfatherly. As long ago as 1851, at the time of the first Great Exhibition, there was a gathering of eminent statisticians in London. Among them was Quételet, who was at one time mathematical tutor to the Prince Consort, and later was his personal friend. Chiefly at the instigation of Quételet, the question of instituting periodical International Congresses for the discussion of statistical questions of general interest was mooted, and, as a consequence, the first International Statistical Congress was held at Brussels in 1853. In 1860 the Congress was held in London, under the Presidency of the Prince Consort, who was, it may be recalled, Patron of this Society from 1840 to 1861. The Prince Consort, in his opening Address to the Congress, defined its aims and objects in the following terms :—

“ It is the social condition of mankind as exhibited by enumerated facts which forms the chief object of the study and investigation undertaken by this Congress. The results of its labours will doubtless afford to the statesman and the legislator a sure guide in his endeavours to promote the social development and happiness of the Nation. The importance of these International Congresses cannot be over-rated. They not only awaken public attention to the value of these pursuits by bringing together men of all countries who devote their lives to this work, and who are thus enabled to exchange their thoughts and varied experiences ;

they also pave the way to an agreement among different Governments and Nations to follow up these common enquiries, in a common spirit, by a common method, and for a common end."

These words may be found on record by any student of the Society's *Journal*, but they bear repetition, after an interval of sixty-five years, as testimony to the one increasing purpose which was believed, then as now, to justify international co-operation in statistical matters. We are all internationalists now, but even the mid-Victorians, in spite of their inveterate insularity, sometimes saw visions.

The International Statistical Congress met at intervals in different countries, but for various reasons it failed to fulfil adequately the purpose of its being, and in 1885, when the Statistical Society held its Jubilee Meeting and again welcomed a number of distinguished statisticians from other countries in London, the occasion was taken to establish the International Statistical Institute. As King George, then Prince of Wales and Honorary President of the Society, stated in his Address at the opening of the Session of the International Statistical Institute in London in 1905 :—

"The Royal Statistical Society will always look back with pride to the happy coincidence of its Jubilee with what may be described as a second birth of international statistical co-operation."

The historical association of the Society with the International Statistical Institute and its origin is my excuse for inviting the attention of members not only to the proceedings at its latest Sessions—for which there are many precedents—but to the wider question of the scope and functions of the Institute, and the extent to which it now carries out the aims of its founders under conditions which they could not foresee, differing very widely, as they do, from those of forty years ago.

The Institute is an unofficial organization established with the general object of promoting the development of administrative and scientific statistics, and especially to discuss and to recommend methods for securing the greatest possible measure of comparability in the statistics of different countries. Its membership is limited to 200 ordinary and 20 honorary members, and candidates for election must be proposed by five members and are subject to a ballot by correspondence. Without going into details, it may be said that entrance is not made easy, and that usually many candidates fail to get the necessary quota of votes for election.

The Sessions of the Institute are held biennially, and up to the outbreak of the war it had met fourteen times, beginning at Rome

in 1887 and ending at Vienna in 1913. During the war its activities were necessarily suspended, and the first Session after the war was held at Brussels in 1923. The intervening ten years had taken heavy toll of the membership, which was reduced to 6 honorary and 132 ordinary members. The result of the first elections after the war, in August and September, 1923, was the addition of 1 honorary and 16 ordinary members. In the following year a large number of candidates were nominated, of whom 3 honorary and 18 ordinary members were elected at the first ballot and 16 more at subsequent ballots. At the date of the Sixteenth Session at Rome the total was 8 honorary and 167 ordinary members, but even since then death has continued to make gaps in the ranks of the Institute. Amongst those whose loss we deplore, this Society has especially to lament the recent death of Sir Athelstane Baines, who was elected a member in 1897 and took an active interest in the affairs of the Institute, attending seven of its Sessions. On more than one occasion he presented papers to the Society on the proceedings of the Institute.

At the Vienna Sessions of the Institute in 1913, a project, which had been for some time previously discussed, for the establishment of a permanent statistical office as an adjunct to, and under the authority of, the Institute, came up for decision. After animated and prolonged debate it was resolved to set up such an office forthwith. The doubts expressed by certain members in the course of the debate, as to the expediency of this development, were partially allayed by the consideration that the scheme might be adopted experimentally, and that its operation could be reviewed at the next Session of the Institute, which was then appointed to be held in Brussels in 1915. The next Session, as already noted, was not held until 1923. The Secretary-General, and consequently the official headquarters of the Institute, happened fortunately to be situated in a neutral country, and it was thus possible to carry out the mandate of the Institute. This Dr. Methorst did with characteristic energy and assiduity.

The functions of the permanent office as set out in the regulations adopted by the Institute at Vienna are, shortly: to collect a library of statistical documents; to facilitate the unification of methods in statistical enquiries so that the results may be as comparable as possible; to publish an "Annuaire" and a periodical "Bulletin," and to assist the Bureau of the Institute in preparing the programme for the biennial Sessions.

The finances of the permanent office are entirely distinct from, and impose no liability upon, the funds of the Institute. The regula-

tions contemplate a subvention by vote of the General Assembly, but no sum has yet been voted. The expenses of the office have been met by subventions of varying amounts from the Governments of fourteen countries, the Municipality of The Hague, and the Carnegie Corporation.

In November, 1923, Sir Athelstane Baines read a paper before the Society on "The International Statistical Institute and its Fifteenth Session," in which he gave, in that lucid and lively style which distinguished all his contributions, a brief description of the interregnum in the history of the Institute and of the position as it presented itself on the resumption of activities. He referred to "the steps taken by the League of Nations, through its Economic Section, to enlist the advice of the Institute upon the grave question of the collection and standardizing of international statistics"; to the Conference of representatives of international organizations and other statisticians convened by the League in August, 1919; to the Committee which met in Paris in October, 1920; to the resolution of the Conference of Genoa, recommending the establishment of a common base for international economic statistics; and to the subsequent invitation of the Economic Section of the League to the Bureau of the Institute to co-operate in the appointment of a joint Committee—which became known as the Preparatory Committee—to draw up a series of reports on specific subjects for discussion by the Institute and subsequent submission to the League.

The Institute, like every other organization, and particularly those having an international basis, was profoundly affected by the war and its reactions. It resumed its activities unchanged in form. But those who were present at Brussels and remembered the pre-war meetings were conscious of a subtle change in spirit. Action had been taken which would have shocked the susceptibilities of many of the older members by their irregularity. The rules of the Institute had been flagrantly violated by an Executive which was reduced to three effective members, and their arbitrary and illegal action was cheerfully condoned by the General Assembly. Arrangements had been made by the Executive, for which there was no precedent, to co-operate with another body which was not in existence, or even dreamt of, before the war. The full significance of the change which had taken place was not realized. Members foregathering at Brussels were more inclined to congratulation on maintaining the continuity of the Institute than to consideration of the new conditions which confronted it. That an old chapter in the history of the Institute was closed and a new one opened was only vaguely realized, and the implications of that fact were ignored.

It was left to the succeeding Session—that opened at Rome last September—to consider seriously the questions which arise in regard to the adaptability of the constitution, organization, and administration of the Institute to the new order of things.

All commentators on the meetings of the Institute have referred to the fact that much happens on these occasions which does not appear in the official records. Conversations and informal conferences between members form no small or unimportant part of the proceedings. As soon as members met at Rome it was evident that the question of the desirability of a reconsideration of the rules had arisen independently in the minds of many. It did not appear that any definite proposals for alteration had been formulated—or, indeed, that there was any explicit desire for alteration. But there was evidence of a feeling that the situation should be reviewed, in view not only of the obvious change in environment, but also of the fact that a large number of new members had been elected who were entitled to have an opportunity of making suggestions.

The occasion for bringing the subject before the General Assembly arose on the fourth day of the Session, on the Report of the Secretary-General. This admirably compiled Report dealt both with the affairs of the Institute and also with the activities and finances of the permanent office of which the Secretary-General is *ex officio* the Director.

After a general discussion of the Report, a resolution was unanimously adopted appreciative of the work done by the permanent office since 1913, thanking those Governments, towns, and institutions which had contributed to its funds, and felicitating Dr. Methorst and his assistants on the results of their efforts.

Mr. Willcox, one of the Vice-Presidents, and consequently a member of the Bureau, then moved a resolution which was also adopted unanimously, requesting the Bureau to report to the next Session whether, by reason of the changes which have taken place since 1885, and especially since 1913, any modifications are desirable in the statutes of the Institute or the regulations of the permanent office, and, if so, what. The Bureau was asked to prepare its Report, and circulate it to each member of the Institute at least six months before the opening of the Seventeenth Session. Subsequently the Bureau agreed that, before preparing its Report, suggestions should be invited from every member of the Institute. A communication in this sense has accordingly been circulated by the Secretary.

I may be permitted, as a member of the Bureau—which in accordance with invariable practice, includes among its six members

not more than one of any nationality—to appeal to those members of the Institute in any country who are readers of the Society's *Journal*, to give the Bureau the benefit of their considered views on this important occasion. I would further express a hope that members will make a special effort to attend the next Sessions, when the question of a revision of the rules will be considered and a decision taken.

This affords a convenient opportunity for recording the fact that, under the rules, the place of the meeting is decided at each Sessions and is usually the last business done. At the concluding meeting of the General Assembly at Rome, two invitations were received, one from the Government of Poland to hold the Seventeenth Session at Warsaw, and the other from the Government of Egypt to hold it at Cairo. On a ballot, the members decided by a majority of 31 to 21 to accept the invitation from Egypt for 1927.

I have dwelt at greater length than I intended on general questions, and to deal with the particular subject of the Sixteenth Session I must summarize severely.

The Session was formally opened on September 27, 1925, in the hall of the Senatorial Palace at the Capitol, by Signor Belluzzo, Minister of National Economy, after Signor Cremonesi, Commissaire Royal for the City of Rome, had welcomed the members. All subsequent meetings were held at the pleasantly situated and commodious headquarters of the International Agricultural Institute.

The deliberative work of the Session was divided between three Sections, as follows:—

I. *Method and Demography*.—President: Professor Benini; Vice-Presidents: Professor Bowley and M. Neculcea.

Classification of industries (M. March).

Application of representative methods in various statistics (M. Jensen).

Sanitary statistics (M. Huber).

Statistics of migration (Mr. Willcox).

II. *Economic Statistics*.—President: M. Colson; Vice-Presidents: MM. Jensen and Wurtzburger.

Census of industrial production (Mr. Flux).

Statistics of production of industries being monopolies or subject to excise duties (M. Julin).

Statistics of stocks (Dr. Methorst).

Statistics of large towns (M. Thirring).

III. *Social Statistics*. -President: M. Sauveur; Vice-Presidents: MM. Gini and Julin.

Statistics of cost of living (M. Giusti).

Statistics of industrial accidents (M. Ney).

Statistics of unemployment (Mr. Hilton).

Statistics of wages (M. Huber).

Of the twelve Reports which were allocated to the three Sections and were thus given priority, four were presented on behalf of the Preparatory Committee, previously referred to as constituted of representatives of the Institute and of the Economic Section of the League of Nations respectively. These were the Reports presented by MM. March, Flux, Julin and Methorst. The Reports on Sanitary Statistics and on Statistics of Large Towns were presented on behalf of Commissions of the Institute appointed prior to the war and re-appointed at Brussels in 1923.

In regard to the Reports submitted to the Third Section, a point of procedure arose which led to animated discussion. In April last the International Labour Office convened at Geneva an International Conference of Labour Statisticians. This was the second of the kind, the first having been held in October, 1923. The objects of both Conferences were identical, and were thus officially stated:-- "To lay down generally agreed principles on methods of compiling labour statistics, in the hope that when any changes in national statistics were made countries would move in the direction of some agreed international standard." At the Conference of 1923 the Agenda was limited to three items: the classification of industries and occupations; statistics of industrial accidents; and statistics of wages. The Agenda of the second Conference was drawn up in the light of suggestions made by the first and consisted of four items: Statistics of the cost of living; International comparisons of real wages; Classification of industries; Statistics of unemployment. The second Conference was attended by 40 representatives from 24 different countries, in addition to one who attended "as observer," and one who represented the Economic and Financial Section of the League of Nations.

Parenthetically, this Society may be interested in noting the introduction of the term "Labour Statistician," the definition of which seems at present vague. The list of representatives at the Conference does not help. The majority were in the service of the countries they represented, but many were Chiefs of Central Statistical Offices of their countries, two were Consuls and one was Professor of Statistics at a University. Of the statistical competence of this Conference, its composition as a whole is a guarantee,

but the claim of each member to be described as a "Labour Statistician" can scarcely be determined without a definition of the term. In any case, I venture to suggest that subjects such as the cost of living and the classification of industries, although no doubt important to those interested in statistics from the Labour point of view, are not less important to all statisticians concerned in sociological and economic problems. That there must be, as there always has been, specialization in statistical work is evident, but I submit that any tendency to sectionalize statistics of common interest—such, for example, as those relating to the cost of living or to Index-numbers—is inadvisable.

To return from this digression: Immediately after the termination of the second Conference of Labour Statisticians, a "Mixed Commission," composed of five members nominated by the International Labour Office and five by the International Statistical Institute, met and considered the resolutions adopted by the Conference. Following the course adopted in the case of the somewhat analogous "Preparatory Committee," the Reports of the "Mixed Commission" came forward to the Institute for discussion. In both cases the Reports, conforming with the usual practice, were considered first in a Section and subsequently in General Assembly.

For any adequate account of the Reports, papers and discussions, those who are interested must be referred to the "Bulletin" of the Institute which is now in course of preparation. I can attempt to give only a few notes.

Of the two branches of statistics allocated to the first Section, that of Method will probably be regarded by many members of this Society as primarily important. There are some who think that the most useful function which can be performed by an organization of statisticians of various nationalities, with diversified experience of the conditions in which statistical work has to be undertaken, is to thrash out in detail the methods which may be generally applied to the collation and analysis of statistical data. The paper by M. Jensen, supplemented by a treatise by Professor Bowley, on the use of the representative or sampling method, dealt exhaustively with a question which inevitably confronts every official engaged in statistical administration. No one contends that in ascertaining facts a part is better than the whole, but everyone knows that in many branches of sociological and economic activity an enumeration of the whole is impracticable for various reasons, among which insufficiency of financial resources is one, and the aversion of the average man from making returns, the utility of which he does not appreciate, is another. As might be imagined, those who took

part in the discussion stressed the dangers of sampling, and a formal proposal was made that the method should only be employed "in exceptional cases," an unimpeachable, but not very helpful, dictum. In the series of resolutions which were eventually adopted perhaps the last may be specially noted, viz., that when results are published based on representative and not exhaustive data it should be obligatory to give a detailed description of the process employed.

On the Demographic side of the work of this Section, reference must be made to the paper by Mr. Willcox, which formulated a project for a compilation and study of the statistics of international migration. The outcome of the discussion of this was the presentation of a resolution to the General Assembly authorizing the Institute to nominate three members "to collaborate with the Bureau of Economic Research of the United States in planning, and selecting contributions for, a volume of studies interpreting the statistics of emigration and immigration of the leading countries or groups of countries from the beginning of the record, provided that the International Statistical Institute shall in no way become responsible for any opinions or conclusions expressed in the volume."

The Section submitted a list of twelve names of members suitable for selection, and the General Assembly on a ballot elected MM. Benini and Verrijn Stuart. MM. Zahn and March received an equal number of votes for the third place, whereupon Mr. Willcox, with general assent, proposed that the number should be increased to four, so as to include both these members.

In connection with this subject, the Section submitted a proposal that the reform and unification of the methods of statistics of emigration and immigration should be placed on the Agenda of the next Session of the Institute. This was modified by the General Assembly into a resolution appointing a commission to study the question and submit a report to the next Session.

The Report by M. Huber on Sanitary Statistics was presented on behalf of a Commission of the Institute first appointed in 1893 and reconstituted at Brussels in 1923, when it was specially charged to consider the revision of the International list of causes of death. Recommendations having for their object the attainment of greater uniformity and comparability were made and approved by the General Assembly, and Mr. Vivian made a proposal advocating the collection of the views and suggestions of Governments derived from administrative experience and recommending co-operation with the Health Organization of the League of Nations. A modification of this proposal in more general terms was suggested and a lively discussion took place, which was closed by referring the question back

to the Section. There was then, unfortunately, little time left before the conclusion of the Session for further deliberation, which might readily have resulted in agreement on an issue which had become very narrow, but in the circumstances Mr. Vivian withdrew his motion.

The proceedings of the Second Section opened with the presentation by Mr. Flux of the Report from the Preparatory Committee on Censuses of Production, which aroused much interest. Certain slight modifications in the drafting of the long and detailed recommendations were accepted, and the conclusions reported to, and adopted by, the General Assembly. It may be said shortly that, while a full description was given of the procedure adopted in other countries, the report substantially adopted the general principles of the British Census.

To this Section Dr. Methorst submitted on behalf of the Preparatory Committee a Report on the collection of statistics of Stocks which was mainly descriptive and, in view of the complexity of the subject, inconclusive, the Committee asking, and receiving, authority to continue their enquiries. The Report presented by M. Julin, also on behalf of the Preparatory Committee, excited some divergence of opinion, and eventually it was resolved that all statistics obtained as a result of fiscal arrangements should be made available and utilized in any international statistics of industrial production.

To the questions dealt with in the Third Section I have already made a general reference. It is impossible here to do more than record that the four Reports from the Mixed Commission on Cost of Living, Industrial Accidents, Unemployment, and Wages, aroused lively discussion, which sometimes verged on asperity, and that in the end they were accepted without substantial alteration by the General Assembly, which also decided to refer the questions of industrial accidents, of real wages and of the relation of wages to the cost of production to commissions of the Institute for further examination.

In attempting to give, without undue prolixity, some idea of the proceedings of the Sixteenth Session, I have necessarily had to resort to the sampling method. Other important papers were presented and discussed, and a large number of papers were circulated but not discussed. The daily "Bulletin," towards the end of the Session, published a list of thirty "communications" which were submitted to the Institute and will, in due course, appear in its official "Bulletin." All of these represented a considerable amount of labour, and in some cases, of original research,

and the discussion of them would have been interesting and no doubt profitable. This, however, would have involved the prolongation of the Session from the customary week to at least a month.

Previous communications to the Society on the meetings of the Institute have revealed the fact that the labours of those who attend the Sessions are not absolutely continuous, and that hospitable amenities form no inconsiderable part of the proceedings. The Eternal City in itself afforded endless opportunity of indulging in day-dreams of the past as a relief from the prosaic aridity of statistical discussion. But the local Committee of Organization, with the King of Italy as Patron, Signor Mussolini as President of Honour, Professor Benini as President, and Professor Sitta as Vice-President, had made sumptuous arrangements for our entertainment. The Executive Committee, consisting of Signori Benini, Sitta, Antonucci and Giusti, were assiduous in their attention to everything which might conduce to our comfort and convenience. The task which they undertook with so much zeal and energy was rendered difficult by the sad death, only a few days before the opening of the Session, of Dr. Aschieri, who was the Secretary of the Committee of Organization, and by whom, personally, the preliminary arrangements had been very largely made. The co-operation of the International Agricultural Institute in the arrangements for our reception not only provided an ideal meeting-place with commodious accommodation, but also gave us the advantage of receiving the untiring attention of Signor Dragoni and the staff of the Institute.

The social functions began on the eve of the Sessions with a Reception by the Minister of National Economy. During the week Receptions were also given by the Commissaire Royal of the City of Rome at the Capitol; by Signor Stringher, Director-General of the Bank of Italy; by the National Bureau of Social Assurance; and by the International Agricultural Institute. At the last-named function the guests were received by Signor de Michelis, President, and Dr. Dragoni, Secretary, and it was attended for a time by Signor Mussolini. The Committee of Organization gave a banquet to all those attending the Sessions, and also gave two luncheons to a number of those having official duties in connection with the proceedings.

This generous hospitality, on what may be termed more or less customary lines, was highly appreciated, but the excursions so liberally organized gave a distinctive feature to the Rome meeting, which will live long in the memory of those who participated in them. To attempt a description of the excursions to Ostia, to the Appian

Way, and the country round Frascati, and especially to Naples and the ruins of Pompeii, would be as presumptuous as, on this occasion, it would be impossible. Of these famous sights, are not the chronicles written in countless books? But nothing can efface the remembrance of the visit to these famous places in circumstances which were made so agreeable by the extreme courtesy and consideration of our hosts. It is not necessary to add that on each occasion refreshment for the body was provided as liberally as delectation for the mind. At Naples a Reception was given by the Commissaire Royal of that city.

In conclusion, the fact should be recorded that among the official delegates from 23 Governments and 4 Municipalities attending the Sessions, the British Government was represented by Messrs. Flux, Hilton, and Vivian, and that the other British members present were Sir Bernard Mallet, Professor Bowley, Mr. Loveday, and myself. That the attendance from this country was qualitatively adequate it is not for me to deny, but I venture to express the hope that at the next and future Sessions it will be quantitatively superior.

DISCUSSION ON SIR HENRY REW'S PAPER.

PROFESSOR BOWLEY: I have pleasure in proposing a vote of thanks to Sir Henry Rew for bringing to our notice the subject of International Statistics, and reminding us of the recent meeting.

I take it that the subject we should discuss to-day is not so much the detail of the Rome meeting, as the rather wider subject—the nature and functions of the International Institute of Statistics; how the functions are to be performed; what are the relationships between the International Institute and the Economic Section of the League of Nations, and the International Labour Office, and other kindred matters of great importance to the whole body of persons who depend upon adequate information of an international kind.

The International Institute has certainly not completed the aims with which it set out in 1885. Statistics of different nations are as yet not in general comparable with each other. The pitfalls of former days are still there, and possibly they are a little more dangerous because they tend to be concealed by the publications of the Institute and Secretariat of the League of Nations, whose monthly Bulletins perhaps suggest that these figures are really comparable.

I have recently had occasion to look into the movements of wholesale index-numbers in some countries in order to determine

whether the low level in Germany relatively to that in the United States ought to alter the cost prices. In my opinion, it is solely, or almost solely, due to a difference in choice of data. I will not give results which are only provisional, but this affords a convenient way of pointing out that comparability has not been obtained in one of the subjects to which particular attention has been devoted by very many statisticians all over the world and particularly at Brussels in 1923.

Sir Henry Rew called attention to a new species—the Labour statistician—and that suggests that we should pay some attention to the work of the International Labour Office. I do not propose to spend my time in praising its activities, but I wish to suggest that the apparent difference of function between the International Labour Office and the Economic Section results in two difficulties: first, that the labour side of the national economy is unduly pressed; and, secondly, that a division is made where no division exists, between the movements of retail index-numbers and of wholesale numbers. There is no such line of division, and it is possible, I think, that better results would be obtained if the statistics were more uniformly under one direction.

International statistics are, of course, impossible until there are national statistics; the whole body cannot be stronger or better than its parts. And I doubt whether there is any real progress in national statistics. The present policy here and elsewhere is to cut down expenditure. Perhaps that is not always a bad thing, for a great deal of the time spent on statistics is probably wasted. Moreover, I doubt whether there is too great willingness on the part of the public to respond to statistical enquiries. In the war years the public acquired the habit of filling up forms, but have rather lost it now. At any rate, we are no more able than before to get a proper enquiry into wages included in the Census of Production now in progress, which shows no great development compared with its predecessor. The things that we chiefly want to know for comparison with other countries, are not the things which we are able to learn. Relative production, stocks, and the division of the product between capital and labour are among the subjects on which we should like information. I could go through a list of statistical subjects without being able to say of any that we had made much progress. I do not think other nations have advanced much more, with the very important exception of the United States, where we find a definite public demand for statistics. Large amounts of money have been spent on statistics, and there has been abundant willingness to give all the information there is, and rather more. I instance this to show the difference between the United States and ourselves in the matter of providing statistics on the subjects not only locally and nationally interesting, but on those which, in the present state of international politics, are necessary for carrying on international public affairs. I could go further and say that in the countries that have no organized thinking department in statistics this state

of affairs is likely to continue, but to develop that would take us too far from the subject of the address.

How can the International Institute or its colleague, collaborator, or rival, the Statistical Department of the League of Nations, improve international statistics? It is a long step from the resolutions in Geneva or Rome to getting the necessary legislation through uninterested Parliaments and obtaining the information from reluctant manufacturers or others concerned; and in fact, though I have no doubt that under the auspices of the International Institute a great deal has been done towards securing the uniformity of statistics and improving their presentation and nationalizing them all the world over, yet there is a lack of machinery to connect the deliberations of either body with the actual production of statistics.

The question I should like to hear discussed to-night—and there are persons present capable of discussing it—is, which is the better organism, the International Institute or the League of Nations, for obtaining international statistics, in the sense of getting the necessary legislation or essential co-operation of departments and the necessary spirit of willingness on the part of the public to give what was wanted?

Sir Henry Rew has described how a certain amount of co-operation has been secured, and mutual help rendered between the two bodies I have named. He did not describe, excepting in guarded language, the difficulties which have arisen from that co-operation, and I will not attempt to go any further in unveiling the secrets of the Institute, but co-operation must inevitably be difficult. It is difficult for two bodies to spread out their lines of work and each do what is proper for itself without any duplication. Consider, for example, the monthly Bulletins published by the League of Nations and the International Institute; they include to a great extent the same material, but not always on the same basis.

The function of the International Institute is, I think, four-fold, and the most successful is the introduction of statisticians to each other, and if for no other purpose than this, I hope it will continue to meet, and not often meet so far away. The second function, to which it has mainly devoted itself, is the co-ordination of statistics, the technique of statistical collection and presentation. The third function is the discussion of scientific method. In that I am not certain how far the Institute is in a good position. In pure scientific method, *e.g.* relating to serial correlations or any other subject thought of in abstract terms, we are not going to get very far in an unprepared discussion round the table. We can, indeed, get some distance by finding out the prejudices of different people concerned, and how far they may be resolved. That is helpful, and may lead to some discussion. The most valuable discussion, however, is not on method, but on the kind of papers given at the Statistical Society—results of investigation in this subject or that. We are told there were thirty such papers communicated; but few of them were discussed.

Some of the hours set down for discussion in Rome were not, in fact, occupied by discussion, and the Congress might well extend its meeting to more than a week.

I suggest that there is room for a variety of functions at the Institute, but there is no agreement as to their relative importance.

In conclusion I should like to ask whether in fact the publications of the Institute have sufficient publicity; whether the results of these discussions and papers presented are in fact known to the general statisticians? The original issue is small and I doubt whether libraries generally get copies, and whether the fact of a particular decision or resolution passed at the Institute is known to statisticians other than those who have some direct connection with the Institute. If that is so, perhaps the Institute might devote itself to making its own good works more widely known.

MR. JOHN HILTON: We are all very grateful to Sir Henry Rew for giving us the opportunity afforded by his paper for discussing the present position of the International Statistical Institute.

Until reading the paper I had not realized how closely associated in origin the Royal Statistical Society was to the International Institute. I discover from the paper that the Royal Statistical Society was at once the father, midwife, and in all probability the grandfather, of the International Institute, and it is clear that a Society which took so comprehensive a part in the origin of such a progeny ought to follow its career with the greatest possible interest. The infant is no longer as young as it was, and in course of growing it would seem to have developed some of those traits—such as exotic fancy, waywardness, and super-sensibility—which are often found in children of cosmopolitan ancestry. The time has come, I think, to consider what should be done to ease these tensions and to give the Institute a status and function appropriate to the circumstances of the present time.

The world in which the Institute now finds itself is different from that in which it was originally conceived. The differences have already been pointed out; the main one is that there have come into being since the formation of the Institute certain organizations which cover, with a different authority and from a different starting-point, some sectional parts of the whole statistical field. There are, among others, the League of Nations, the International Labour Office, and the International Agricultural Institute, and I think I am right in saying that there have been convened, in the last forty years, an increasing number of international gatherings of specialist statisticians for the purpose of co-ordinating international statistics in particular fields.

In what I have to say I shall confine myself to two of the organizations which have come into being since the war—the League of Nations and the International Labour Office. The important distinction, as I see it, between these two organizations and the International Institute, is that they are inter-governmental

organizations. Their statistical activities are controlled by persons who are sent to these organizations by their Governments, who can speak on behalf of their Governments, and who go back to represent to their Governments what has been done. The International Institute has no such status.

This is not the first time that the problem of reconciling the work of the Institute with that of these other organizations has arisen. As Sir Henry Rew says in his paper, it was broached in the session preceding the Brussels meeting. Since that time there have been certain tentative efforts at co-operation between the International Institute and these two organizations, but these have not been uniformly successful.

I cannot speak with first-hand knowledge of the relations between the International Institute and the League of Nations, but if I understand rightly, before resolutions are framed by the Economic Committee some kind of ill-defined Joint Committee, constituted partly of persons representing the Economic Committee, meets and confers in a preliminary sort of way, and what the Economic Committee of the League, or the League itself, may do after that is taken as having been done with the advice and assistance of the International Institute.

The relations between the International Labour Office and the International Institute have not been quite of that character. I hesitate to go too deeply into this matter; Sir Henry Rew and I have discussed it on many occasions, and we shall no doubt discuss it on many more, but I think I ought to make plain in very general terms what the difference has been.

Sir Henry Rew has referred to the fact that in recent years two Conferences of Labour Statisticians have been convened under the auspices of the International Labour Office, and Sir Henry Rew asks in passing, "What is a Labour Statistician?"

I will try to answer the question. A Labour Statistician, for these purposes, is a person who is sent by his Government to attend a Conference which is convened specially to discuss labour statistics and to come to certain agreements with the Labour Statisticians of other countries on very practical matters concerning labour statistics and intimately affecting the administrations responsible for the collection and publication of labour statistics. He is a person who in giving his agreement commits, to some extent, his Government; who goes back to his Government reporting what he has agreed; and whose Government, after he gets back, will receive in due course from the International Labour Office the recommendations that have been passed, with a request to know whether the Government will put them into operation and, if so, to what extent. He, therefore, carries a definite official responsibility.

The two Conferences to which Sir Henry Rew has referred, were Conferences of Labour Statisticians so defined. Perhaps not all of us were ideally competent to discuss the subject of labour statistics;

but, at any rate, we were *authorized* to discuss them, and that is what matters for the purposes of the distinction I am making.

Up to the time of the second of these Conferences there had been no formal co-operation that I am aware of between the International Labour Office and the International Institute, but after the second Conference, as Sir Henry Rew has described lucidly and correctly in his paper, a Joint Committee was appointed, consisting of five members of the International Institute and five members representing the International Labour Office, persons who had been taking part in the Conference of Labour Statisticians; and this Joint Committee sat to consider the agreed and adopted resolutions of the Labour Statisticians who, on the preceding day, had risen from their labours.

I will not go at any length into difficulties that arose as a consequence of this course of action; but the first thing the Joint Committee had to ask itself on assembling was, What are we to do with these resolutions that have come before us? Those members of the Joint Committee who, like myself, had presided over sections of the Labour Statisticians' Conference, were in a position of exceptional difficulty. We had just risen from agreeing, with our colleagues, as a result of many compromises and keen discussion of opposed views, every word and phrase of the resolutions. How could we now lend ourselves, in the absence of our colleagues, to modifications of the text agreed with them? My own view was, and still is, that the Joint Committee had no title and no business to introduce modifications into the resolutions; it must confine itself to making comments on the resolutions from the larger scientific standpoint. At the Joint Committee that view was eventually accepted and adopted; but when the Report of the Joint Committee came before the Session of the International Institute at Rome the President gave a ruling in the contrary sense, and the Institute proceeded to introduce trifling, and I would even say frivolous, modifications into the text. That was, to my mind, an unfortunate decision, leading to an impossible situation.

I refer to this as illustrating the difficult position in which the Institute now finds itself, and as reinforcing what has already been said as to the necessity for the Institute to consider more fully than has yet been done its proper rôle in the domain of international statistics.

There is, therefore, every reason to be gratified at the resolution put forward and passed at the Rome Session, recommending that the constitution of the Institute be examined by the Bureau, and that the Bureau should receive suggestions from the members.

In pursuance of this resolution it behoves members of the Institute to take counsel together as to the type of modifications that ought to be proposed. Professor Bowley has indicated a line of policy in this matter towards which, for my own part, I incline. The aim of the International Institute as it was originated was to promote international uniformity and comparability in statistical

matters. The Economic Committee of the League of Nations, and the International Labour Office, are at the present time covering a very considerable section of the statistical field as regards the achievement of improved form and greater comparability; and, as I have said, they are better implemented for that work than the Institute can possibly be. It would seem, therefore, that the Institute, while not excluding itself from the consideration of the international aspects of any branch of statistics, should direct itself more specially than in the past to the scientific aspects of world statistics and should leave questions of administrative method and official action to those organizations which have official status and authority.

It has seemed to certain members of the Institute that the proper functions of the Institute, in the world in which we now find ourselves, might be better expressed as one of promoting the development of scientific methods in the collection and utilization of statistical data and a knowledge of the material, moral and social conditions of the world in so far as they can be ascertained by statistical method. These members envisage an Institute which would perform this function in four main ways, first, by preparing, discussing and publishing papers concerning such scientific problems of statistical method as are likely to arise in all branches of statistics—averages, samples, correlations, etc.; second, by preparing, discussing and publishing statistical papers concerning such material, social and moral conditions of mankind as are of international interest; third, by summarizing and publishing the most important articles appearing in all languages in the scientific press of the world on the above subjects; and fourth, by establishing permanent personal relations between statisticians in different countries.

I convey these suggestions as a contribution to the discussion. Members of the Institute appreciate this opportunity of conferring with the Society upon the question of the future of the Institute and would be grateful for any suggestions which would give them guidance. Some members might like to turn their attention to the somewhat anomalous relationship between the International Institute and the Permanent Office, an organization which is financed as a separate entity, yet expends its funds in carrying out activities under the aegis of the Institute. It is a curious position, in that the Institute has no funds of its own with which either to publish statistical papers or to carry on any but the most fragmentary inter-sessional activities. Members, while appreciating the services rendered to statistics by the Permanent Office, may think the time has come for reconsidering its relations with the Institute.

May I deal with one point on statistics generally raised by the mover of the vote of thanks. Professor Bowley was, I think, unduly doleful as to the attitude of the public towards making statistical returns. The position has changed somewhat in that it is more necessary now than before the war to consult organizations of employers and workpeople before making statistical enquiries of

their members, but our own experience has been that when good cause could be shown for making the enquiry the organizations have generally been ready to give not only endorsement but active assistance, and their members have responded most cordially to the enquiries that have been sent out.

In regard to the obtaining of wages information in connection with the Census of Production, it is quite true that no wages information is being obtained by the Board of Trade in connection with that Census; that is ruled out by the Act under which the Census is taken; but the Minister of Labour, after consultation with employers' organizations, is making an enquiry into the earnings and hours of workpeople which will afford information on these matters for the same period as that covered by the Census of Production. Although there are no compulsory powers and it is being done on a voluntary basis the returns are coming in very satisfactorily. In other enquiries also the experience of the Ministry of Labour has been that, provided the organizations concerned are suitably consulted, the apathy indicated by Professor Bowley can be changed into cordial assistance.

Mr. S. P. VIVIAN said that both Professor Bowley and Mr. Hilton had suggested definitions of the proper functions of the Institute in positive terms, and he found himself largely in agreement with what they had said. He would like, however, to approach the subject from the other aspect, and to attempt to define by exclusion. There seemed to him to be a large field of statistical subjects which he could only define roughly in the following manner: that their discussion or treatment was intended to lead to advice or recommendations, effect to which could only be given by the action of Government departments. All were familiar with examples of this, and it seemed to him that that was an unsuitable province of statistical inquiry for a body which had no machinery for consultation with Government departments.

In his own experiences in Rome—his first experiences of the kind—he found himself in a certain amount of perplexity on the subject. He referred to a little matter mentioned in the paper, not because it was of importance as compared with other matters mentioned, but because it was not uninteresting as regards a certain attitude of the Institute towards its own functions. The matter related to the future revision of the international list of causes of death, which was obviously a subject within the definition suggested, inasmuch as that revision in effect took the form of an agreement on the part of all the departments concerned to alter their methods of classifying causes of death.

His proposition—and he took leave to correct an impression that might have been formed—was not to suggest to the Institute that it should itself take action to collect information from Government departments, but merely that it should record the opinion that the collection of such information was a necessary and essential part of

the preparations for the next revision. That proposition was followed by a discussion and a corollary in the form of a second resolution that such action should be promoted by the Institute through the League of Nations. To his astonishment he found that the set of resolutions was ruled out of order. He did not understand that the opinion which he had requested the Institute to record was in any way dissented from; but the matter was ruled out of order, apparently, because it referred to Government departments and Governments, and the Institute felt it shocking that such things should be mentioned in resolutions intended to be passed by it. Two inferences could be drawn from such an attitude :—

- (1) That it was somewhat anomalous for the Institute to invite Governments to be represented at its proceedings. He attended the meeting as a representative of his Government, and on attempting to secure a resolution of interest to his Government he found it to be out of order for that very reason.
- (2) That the Institute ought at once to recognize that such a ruling was only consistent with complete abstention from the consideration of any subject within the class that Mr. Vivian had attempted to define.

Mr. Vivian hoped these two consequences of the action of the Institute and of its own ruling would be taken into consideration in connection with the revision of its statutes. It was not a question of status or privilege as between the bodies; it was purely a question of function and machinery for its discharge. Mr. Hilton had described the difficulties that must arise where a matter which closely affected a Government or Government department was handled by a body which had no machinery for consultations or responsibility for giving effect to its conclusions. There was enormous scope for the legitimate activities of the Institute, and he trusted that it would direct its energies in a manner which would increase their value and utility.

Mr. A. W. FLUX said he would like to make some observations on matters that had occupied the attention of earlier speakers. The first was the effectiveness of discussions that took place at the sessions of the International Institute. Professor Bowley commented on that and appeared a little pessimistic as to the utility of the discussions.

It was only fair to recognize that, for the last two sessions of the Institute, the Joint Committee set up by the League of Nations in connection with the Institute had prepared reports intended for circulation in advance of the meeting. Perhaps, particularly on the last occasion, some of these reports were not available as early as all this preparatory work might have been expected to achieve; one or two of the reports were not available on the first day of the discussions, although some months earlier they had apparently been ready for printing and circulation. These, however, were little accidents of the human working machine and did not detract from

the fact that there was a mechanism intended to secure the desired end, if only the sand could be got out of the bearings. If this circulation were made, instead of members meeting round a table not knowing what views would be expressed, they would come knowing exactly what would be put before them, so that the discussion of twelve people round a table might be very effective and might get at the root of the differences between different countries, finding out when it was possible for different countries to compare statistics and the most helpful conditions of change, with a view to ensuring a greater amount of comparability in the future.

That question did not arise before the war. Papers were prepared and circulated in advance. The fact that the machine was not yet in proper working order was a fact to be borne in mind in connection with the meetings at Brussels and Rome. The League of Nations, in its measures of co-operation with the Institute, had done quite a good deal to smooth the way back to something like the old practice of ensuring that when the Institute met members would know what was to be discussed.

This understanding of each other's difficulties by officials of different countries, as well as the advice that could be given by the academic members of the Institute on high points of theory, detailed attention to which was very important, constituted one of the greatest services rendered to international statistics in the best sense. It did not achieve immediate comparability, but it created an atmosphere in which an approach to comparability was to be expected. If it did not do that it was not doing what was expected of it by the Royal Statistical Society when it took a hand in forming the Institute some forty years ago.

Reference had been made to the Permanent Bureau. His attention was definitely attracted by one reference made by Sir Henry Rew to that body and its setting up as a result of the Vienna meeting. He was surprised at that meeting to find that it was held by a majority of those present that a decision, which he anticipated would be taken at the Vienna meeting, and which Sir Henry Rew still believed to have been taken at Vienna, was taken at the preceding meeting, and it was no longer open for decision whether a Permanent Bureau should be created. What was open for decision was the tasks to be assigned to the Bureau and how they were to be carried out. That created a very unfortunate position, and but for this difference of opinion in the body of the Institute itself the Institute might have been in a much less embarrassed position to-day.

In 1913 it was impossible to conceive of the creation of the League of Nations; had it been possible to foresee that he could not believe that a body of eminent statisticians would have established a Permanent Bureau in the manner in which it was established. It existed, however, and there remained the problem of arranging its relations to other bodies. It seemed to him that the attention

of the Institute would have to be given very carefully to the best means of ensuring that a body, which was in existence, and might reasonably be expected to remain in existence, should so arrange its activities that they should not overlap the activities of other bodies which had come into existence as the result of political events since its establishment, and whose right to work was unquestionable. A limitation of the field of activity must be found which would enable the Institute and the Permanent Bureau to carry out their work without merely duplicating what had been done elsewhere.

Professor Bowley referred to a case of the presentation of two sets of statistics professing to represent the same phenomena which were not identical. That suggested a field of activity for the officials on one or both sides.

He would like to say a few words with regard to the League of Nations publications to which Professor Bowley had referred. In addition to its monthly Bulletin, in which certain trade figures and price indices were set out, the League had taken the trouble to publish some documents which ought to be read with those figures. It had given a good deal of attention to the modes of compilation of the figures set out. The careful student could not afford to neglect the Memoranda in which this information was given. Though for the purposes of the monthly Bulletin it was not practicable to include statements regarding the degree of comparability of its figures, there were thus available books of reference which would enable the diligent student to see what red flags ought to be shown at different parts of the columns of figures, and in what way he might avoid drawing incorrect conclusions from considering various sets of these figures side by side. That ought not to be forgotten in looking at the danger of setting out in the Bulletin data not wholly comparable with one another.

Professor Bowley referred to the question of price indices. On that he (the speaker) would like to say that, in his opinion, the more important of the uses to which indices of wholesale and retail prices could be put were uses that required that these indices should be adapted to the circumstances of the country for which they were prepared and to which they were applied. That they should be comparable to indices adapted to the circumstances of other countries was a desideratum, but if the two could not be got the choice should lie on the side of their representative capacity in respect of the conditions they were professing to represent, each for its own country.

The position might presently be reached that, in addition to these local indices prepared by local statistical authorities for local use and consumption, there might also be prepared some other indices in which international comparability would be a large consideration. There existed the difficulty—a difficulty felt badly enough at the present time—that when different indices were given out for the same country, if these indices moved differently, how

was one to say which was true. If an attempt were made to say that they were both true, that they were dealing with different things and therefore might naturally differ as between themselves without one or other being false, the man in the street found it a little difficult to understand. For this reason he would suggest that such international data—at any rate in the early stages of their compilation—would have to be prepared mainly for the consideration of those who were accustomed to look under the surface of things, and who would not have any difficulty in finding that two indices professing to represent the movement of prices in the same country, even if they did not run exactly parallel to each other, might both be true.

He (the speaker) wanted very badly some indices which would bear directly upon the problem that found a considerable place in the newspapers to-day: How are prices moving in this country and America in reference to the movements of the exchange? The correspondence of exchange movement with price movement was the thing sought for. He did not as yet conceive in his own mind just what should be the construction of price indices that would really, truly and directly be applicable to this problem of measurement of relative price movements with a view to seeing how far exchange movements corresponded to these price movements.

Sir Henry Rew had referred to a paper read before the International Institute, and suggested that it set up as a standard the general principles of the British Census. He wished to add that it did not lay down, as the ideal international standard, the principles of the British Census Act, which contained a number of restrictions not recommended for international adoption.

Reference had also been made to the prospective work on the statistics of Stocks and Current Production. In conclusion, he would like to issue an invitation to any Fellow of the Royal Statistical Society who could assist him with information about the statistics of current production in given industries prepared by associations of producers in those industries, the manner of preparation and where they were obtainable, and similarly with statistics of stocks in various trades. He wanted to be able to present to the Preparatory Committee, when it next met, as complete an account as possible of what was available in this respect in this country and in the British Empire. He would be deeply grateful to any Fellow of the Society, or anybody who was not a Fellow, for any assistance they could give in presenting to the Preparatory Committee an account of the statistics of the British Empire in this field, and as exhaustive an account as could be made.

Mr. BRACE said that, following up Professor Bowley's second proposal with regard to what he (Professor Bowley) considered should be one of the functions of the International Institute of Statistics—the co-ordination of statistics—might he suggest that there was already in existence a means at the disposal of the Institute for

assisting to realize that ideal. He referred to the monthly Bulletin of Statistics which was published by the Permanent Office.

He had had occasion recently to consider statistics of mineral production published in that Bulletin, and to his surprise he found that those statistics were in many cases misleading. To give one instance—typical of the statistics of mineral production generally—in the case of South Africa some figures of production of copper ore were given which on investigation were found to consist of figures of production of copper concentrates and of blister copper. Blister copper contained 94–99 per cent. copper, while the copper content of concentrates covered a wide range, the particular concentrates in question containing about 50 per cent. copper. In the monthly Bulletin of the Permanent Office he found that the two figures had been added together and given as the production of blister copper and copper concentrates without any indication as to the difference in copper contents of the two grades.

He suggested that, as far as possible, statistics of mineral production published in the Bulletin should be arranged in two columns, the first column giving the quantity of ore produced, and the second the metal content of the ore produced.

Another instance of the need of co-ordination was to be found in the case of manganese-ore production. He suggested that the International Institute might use its influence to find out what was really meant by the manganese ore returned as being produced in the various countries. It was the usual practice to include manganiferous iron ore, containing up to 30 per cent. manganese, with iron ore, and he thought this was done to some extent in the case of iron-ore production statistics in the Bulletin. One was at a loss, however, to ascertain what quantities of manganiferous iron ore had been included. Again, the United States, which was a large producer of manganese ore, published figures which ranged from 5–10, 10–35, and over 35 per cent. content of manganese. Thus it was difficult to ascertain in that case the quantities of manganese ore containing less than and more than 30 per cent. of manganese. Here was an opportunity for the International Institute to use its influence towards obtaining comparable statistics.

In conclusion, he suggested that the monthly Bulletin should become the medium for securing co-ordination in international statistics, and that it might thereby become the means of bringing the Permanent Office and the International Institute into a more intimate co-operation than apparently existed at the moment.

Mr. NIXON said that Sir Henry Rew had deprecated the introduction of the words "Labour Statistician," but Mr. Hilton had justified the use of the term. There were already in use such terms as "Economic Statistician," "Medical Statistician" and "Vital Statistician," and he thought that the term "Labour Statistician" could not be objected to at this stage, and hoped it would be allowed to remain.

Mr. Vivian had given an able description of the relations between the International Statistical Institute and the League of Nations and the International Labour Office. The attitude of the International Labour Office throughout had been that it must act through Governments. If reform was necessary in the comparability of statistics, it could only be obtained by the action of Governments.

It had been suggested that there was overlapping and duplication between the League of Nations and the International Labour Office in statistical matters. As a matter of fact, there was the fullest co-operation between the two bodies; there was no duplication, and overlapping was reduced to the smallest possible amount. A Committee consisting of the statistical officers of the two departments existed to discuss all points that arose.

On p. 73 of the paper Sir Henry Rew referred to the fact that the Economic Committee and the Institute had appointed a "Preparatory Committee" to deal with statistics affecting the League of Nations; he also referred on the next page to the fact that the International Labour Office and the Institute had formed a mixed Committee to deal with statistics affecting the International Labour Office. He might, perhaps, have added that the former Committee contained a member of the International Labour Office, and the second a representative of the League of Nations. By that means the fullest co-operation was obtained between the two institutions.

The CHAIRMAN said that as time was getting short he must close the discussion, and would not himself add to its length excepting to express his own thanks to Sir Henry Rew for having read a paper which had led to such an interesting discussion. He now put a formal vote of thanks to the meeting, which was carried unanimously.

Sir HENRY REW thanked the Society for the kind reception given to his paper. He would make only one or two remarks, owing to the lateness of the hour, but he would call upon the hospitality of the Editors of the *Journal* for that purpose. Sir Henry Rew's further comments are incorporated below.

In the paper he had endeavoured to earn commendation for brevity, and he had also intended to be provocative, while being perhaps somewhat guarded.

In regard to the general purpose of the Institute, the Society might draw some sort of analogy. It had been said that the existence of official bodies having a status of responsibility rendered it unnecessary to maintain an organization of such a kind as the Statistical Institute. Much the same might be said in regard to the Royal Statistical Society—that the fact that authoritative departments were dealing with statistics obviated the necessity for the existence of such a Society. Comment and criticism were not necessarily superfluous because statistics were dealt with officially.

Professor Bowley, in his analysis of the situation, rightly said

that the work of the Institute was not finished—that, indeed, it might be in the future even more useful than in the past. The functions he had defined were in fact those which the Institute was designed to fulfil. It might be said that, in a broad sense, its main function was educational. It brought together men from all parts of the world, and enabled them to appreciate the varying conditions in which statistical work was being carried on. In that way, quite as much as by formal papers, the Institute might claim to exert an educational influence on the development of statistics generally. In regard to the question of giving wider publicity to the reports of the Institute probably more might be done; but, as a matter of fact, apart from the issue of free copies of the Bulletins to members, there was a not inconsiderable sale. In this connection Mr. Hilton was mistaken in stating that the Institute did not publish its proceedings independently of the Permanent Office. He would find in the Library of the Society the Bulletins of the Institute from its earliest days, and they were still published quite separately from the special publications of the Permanent Office, which were a very recent addition.

Mr. Hilton had given a definition of a “labour statistician” as a person delegated by his Government to attend a conference on labour statistics. That was certainly not the way in which one would define, for example, a “vital statistician” or an “economic statistician” referred to by Mr. Nixon. The difficulty which Mr. Hilton had found in the fact that he had represented the Government on three different bodies dealing with the same subject did not seem to him (the speaker) insuperable, nor could he understand why the decision of one of those bodies should be insecure from comment or criticism by the others. It was quite true, as Mr. Hilton had pointed out, that the League of Nations and the International Labour Office were “inter-governmental” organizations and the Institute was not. This, in the view of some of them, was one reason why the Institute should be maintained.

Mr. Flux dealt adequately with certain points raised by previous speakers, but in regard to that referred to by Mr. Vivian it might be added, as indicated in the paper, that the difficulty which arose was one rather of phraseology than of substance, and the inference that the whole subject was ruled out of order was hardly justifiable. The subject, indeed, was one in which the Institute had for many years taken an active interest.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society :—

Wilfred Percy Brattle.
Elsie Josephine Mary Bryant.
John Clarke Fox.
Cecil George Freke, B.A., B.Sc.
Austin Bradford Hill.

John Howard Hunt.
William Thomas Orme.
Ben Warren Sparrow.
Eric George Suffell.

DISTRIBUTION OF EMPLOYMENT IN THE WOOL TEXTILE INDUSTRY
OF THE WEST RIDING OF YORKSHIRE.

By ARNOLD N. SHIMMIN.

[Read before the Royal Statistical Society, at a meeting held at the University of Leeds, on December 16, 1925, the President, Mr. G. UDNY YULE, C.B.E., M.A., F.R.S., in the Chair.]

ALTHOUGH the wool textile industry may appear at first glance to be an economic unity, investigation soon reveals the fact that there are really three industries in one. There is the broad distinction between the woollen industry and the worsted industry, and the former has within it two branches, which may be conveniently described as the fine woollen trade, and low woollen trade. These three types of industrial activity correspond broadly with the materials upon which they are based. For the production of its typical fabrics, the worsted industry is dependent in the main upon the longer stapled wools. The woollen trade depends mainly upon shorter stapled wools, and the low woollen trade relies upon rags as a source of its raw material.

If the woollen and worsted industry were divided into three sections on the basis of raw material which could, in each case, be readily standardized, the study of its organization and activities would be relatively simple; but it is well known that wool in itself is a very complex raw material. Apart from the fact that there are hundreds of distinguishable types of wool, there is the over-riding consideration that the suitability of a given type for a particular purpose can only be gauged by actual inspection of the wool. In all cases the clean-scoured content of the wool is a vital consideration which is determined by the actual judgment of the buyer. The fact that there are other qualities demanded of the wool, in accordance with the purpose for which it is destined, tends to emphasize the difficulty of formulating standards in which the market can deal. A pronounced economic individualism in dealing is therefore characteristic of the wool market, and the influence of the raw wool upon the nature and size of the businesses engaged in the industry is very marked.

In view of the fact that the industry is strongly localized and specialized, there is surprisingly little information to be obtained about it. There are very few reliable figures of the production of its raw material in the various primary markets; there is no means at present of securing adequate information about the productive capacity of the industry; no record of machinery activity is available; there is no statement to be obtained of the volume of trade in the home market, apart from what may be learned from an occasional Census of Production; and the industry never knows what stocks of raw material or manufactured goods are being carried at any given time. In view of the absence of information on these vital points, it is gratifying to find that an appreciable amount of information is now available about employment in the industry, through the medium of the Insurance records held by the Ministry of Labour.

The annual exchange of Insurance Books enables the Ministry to secure the totals of the numbers of insured persons at all the chief centres of the woollen and worsted industry. In the course of a detailed investigation of the unemployment returns for the West Riding, I discovered that an Employers' Register is kept at each Exchange which records the branch of the industry to which the firms belong, the full title of the firms, and the numbers of insured operatives employed by them. It will be realized that a record of this kind may prove a very fruitful source of information about the distribution of labour in the industry, and also about the variations in the size and history of the firms, if the records are kept carefully posted from year to year. As these records do not contain any information about the number of juveniles employed by the different firms, the information is much more limited than one could wish for purposes of the study of the size of business; but I feel it is well worth while to attempt in this paper to discern from the facts available some of the main points about the distribution of the industry in the West Riding, the sizes of the firms engaged in the principal centres, and the extent to which limited liability companies exist in the industry. The material to be used is admittedly incomplete, but not, therefore, useless. The range of one's findings might have been extended, but for the fact that the classifications used by the Census authorities and the Ministry of Labour are not identical. In the Industry Tables of the 1921 Census, which were published this year, the following paragraph occurs in the Preface:—

“In the course of the Census preparations, special attention was given to the form of enquiry as regards occupation and industry, with a view to securing an improvement in the statistics

derivable therefrom. It also appears clear, from experience of the 1911 results, that fuller and more scientific classification, both of occupations and of industry than had hitherto been available, was essential to the proper statistical treatment of this subject, and to the utility of the Census results, for comparison with the Census of Production. The Census Joint Committee accordingly arranged for the subject to be considered by a special Sub-Committee, on which the Board of Trade, Home Office, and Ministry of Labour were represented. This body, working with the co-operation of the Departments mentioned, drew up occupational and industrial qualifications, which have been adopted for the purposes of the Census returns, and which, it is understood, have been generally accepted as standard classifications of these Departments."

This statement raised one's hopes that it would be possible to extend the enquiry, and take the figures relating to unemployment in the chief textile centres, so as to trace its incidence in these centres and in the various sections of the industry as set out in the classification used for insurance purposes by the Ministry of Labour. After many months of work collecting the unemployment figures over a series of years, I discovered that the true incidence of the unemployment could not be gauged, because neither the classification used in the Census nor in the Ministry of Labour returns would yield information about the numbers engaged in the various processes of the industry for which the unemployment figures are tabulated.

Thus in the Yorkshire volume of the Census, textile workers are all grouped together under Order XII of the occupational classification, but it is very difficult, if not impossible, to derive from this grouping an exact indication of the numbers engaged in the woollen and worsted industry only, as many of the headings incorporate workers in other branches of the textile industry. Another difficulty is presented by the fact that unskilled workers are grouped under a separate occupational code-number, as are also labourers, thus separating them from the department or process in which they are employed. In the Industry Tables it is true these unskilled and labouring groups are mentioned under the six industry headings for the woollen and worsted industry, but the fact remains that the classification severs the unskilled workers and the labourers from the process to which they belong.

The Ministry of Labour, VB (Woollen and Worsted) Trade Classification, is broadly industrial, with twelve occupational sub-headings which group the "labourers" under the headings of the respective processes to which they belong. These twelve headings

are held to correspond as closely as possible, under the present arrangement, with the six industry-groupings (270-275) of the Census Industry Tables. The difficulty in discerning the relation between the two is shown in the following table, where the figures for the four centres named are compared :—

Woollen and worsted industry.	Census totals, 1921. Industry Tables (270-275).	Totals of insured workers.
Bradford	50,013	60,909
Huddersfield.... ..	15,797	22,287
Halifax	10,963	9,970
Dewsbury .. .	9,971	9,472

In a paper read before this Society in March, 1923, Mr. John Hilton, Director of Statistics to the Ministry of Labour, drew attention to the general problem of classification. He said that the process of dividing up the industrial state into industrial provinces is not a wholly arbitrary proceeding, and expressed the view that "it may be possible in the future to substitute for the present industrial code of the Ministry of Labour one of more commendable structure, preferably one coincidental, as far as possible, with the industry code adopted in connection with the 1921 Census of Population." In replying to the discussion, Mr. Hilton said : " There are great advantages to be derived from a uniform classification for all the purposes for which statistics are compiled, and, in view of that, I hope we shall, at no very distant date, be able to modify the classification used in connection with Unemployment Insurance, so that the figures derived from the workings of the Unemployment Acts may be studied under the groupings conterminous with the groupings used in the 1921 Census."

This statement contemplates the complete acceptance of the Census classification, and while all agree that it is desirable that uniform classification should make possible the study of employment and unemployment returns on the same basis, there seems to be room for discussion before the existing industrial code with its occupational sub-headings, as employed by the Ministry of Labour, is departed from. That classification appears to me to have the merit that it follows fairly closely the actual sequence of processes as one finds them referred to most frequently in the industry. It is an advantage also to have the labourers returned under the heading of the particular process to which they belong. To quote another instance, it also seems desirable and convenient to return each type

of process worker in one group, instead of having four or five different headings, in the form in which they appear in the Industry Tables of the Census, because, after all, the trade is more interested to know how many operatives there are engaged in each process, than how many there are attached to combing concerns and the spinning or weaving sections of the industry. It would appear that the Census arrangement would also offer considerable difficulty in the recording of the unemployment figures relating to the several groups there outlined. So far as one can see, wool sorters, for example, would have to be entered under four or five headings, in accordance with the particular section from which they had come. The difference in the range of ages used in the classification is another difficulty, and comparison of the Census figures and the Ministry of Labour figures is also impracticable on the grounds that the areas of registration do not coincide. The Bradford of the Census authorities is not the Bradford that registers on the Employment Exchange. A further difficulty is the fact that the details of employment at the principal centres can be derived only so far as they relate to all textile workers in Order XII of the Census. It would be considerably more valuable to the industry to have the details for woollen and worsted for all the principal centres of the industry on the Ministry of Labour list, and not just for the West Riding as a whole, and the County Boroughs as given at present in the Industry Tables of the Census. Unemployment figures, based on the Ministry of Labour occupational classification Nos. 319-330, are given in the *Labour Gazette* month by month for each section, but information is not available at the Ministry about the numbers of insured persons engaged in each of these sections—wool sorting, wool washing, wool combing, etc.; and my experience is that the people in the industry would like to know how the total labour supply to which the unemployment figures relate is spread over these sections. When, some day, we get a complete Census of the machinery employed by the different sections of the industry, it will surely be along these lines that the industry will seek to relate the total number of operatives to the machine- and non-machine-using sections of the industry.

Localization.

The concentration of the woollen and worsted industry is clearly illustrated by the fact that there were registered in 1924, within 15 or 20 miles of Bradford, more than 213,000 of the 273,000 insured workers returned in the *Labour Gazette*. The following list states the principal centres of the industry in the order of the number of

insured operatives engaged in woollen and worsted manufacture at each centre :—

Bradford	...	...	...	...	63,490
Huddersfield	...	...	...	...	24,139
Halifax	...	...	...	...	11,944
Dewsbury	...	...	...	...	11,607
Stanningley	...	...	...	...	9,697
Batley	...	...	...	...	9,669
Shipley	...	...	...	...	9,382
Leeds (including Armley)	...	...	...	...	8,960
Morley	...	...	...	...	7,715
Keighley	...	...	...	...	7,622
Wakefield	...	...	...	...	5,380
Spen Valley	...	...	...	...	4,916
Otley and Guiseley	...	...	...	...	4,343
Sowerby Bridge	...	...	...	...	4,049
Brighouse	...	...	...	...	1,253
Hebden Bridge	...	...	...	...	339

The predominance of Bradford as a single centre is clearly shown, and the position of the city is emphasized if the contiguous areas of Shipley and Stanningley are added on the ground that they present the same economic characteristics. Halifax and Keighley are the other two main worsted centres. In Huddersfield most of the firms are woollen firms, but there are a few large worsted firms producing high-class goods. Dewsbury, Batley, Morley, Spen Valley, and Guiseley area may be quoted as the main centres of the lower woollen trade.

As one meets so frequently the suggestion, that in all the textile towns of the West Riding the woollen and worsted industry dominates the economic life of the town, it is interesting to express the numbers of insured operatives engaged in woollen and worsted manufacture as a percentage of the total insured population.

Woollen and Worsted workers expressed as a percentage of the total Insured population.

Town.	Percentage.	Town.	Percentage.
Stanningley	65·6	Sowerby Bridge	36·7
Shipley	63·6	Halifax	30·3
Batley	62·7	Spen Valley	28·2
Dewsbury	57·0	Wakefield	15·7
Morley	52·4	Brighouse	13·6
Bradford	51·9	Leeds (including Armley)	5·9
Huddersfield	45·3	Hebden Bridge	5·3
Keighley	40·3		

It will be noted that these figures relate to the principal centres in which Employment Exchanges are stationed. There are two or three cases in the smaller centres on the outskirts of these main centres where, probably, the percentage of employment may reach higher figures than those shown in the list, *e.g.* Slaithwaite and Holmfirth in the Huddersfield area, and Howarth in the Keighley area.

There are several features of this list which attract one's attention. The low figures at Hebden Bridge and Leeds are due to the fact that at Hebden Bridge one is on the border line of the cotton industry, whereas, in Leeds, woollen and worsted manufacture has largely been displaced by the wholesale clothing industry.

The figure for Bradford is lower than one may have expected, but it serves to bring to light the fact that a large part of the wool activity in Bradford is associated with dyeing and the merchandising of raw wool and finished goods.

If it were possible to include the appropriate figures for these sections the percentage of employment directly attributable to the woollen and worsted industry would be very much higher.

The Halifax figure is lower also than one would normally expect, in view of the fact that the town stands third on the list of wool textile centres in the area.

At Keighley there is the close association of textile engineering with the manufacture of wool and worsted goods.

In Table I, a detailed list is given of the numbers of insured workers in the chief industries in the principal textile centres.

Sizes of Firms.

When we come to consider the distribution of workers over the firms in the industry, a difficulty is presented by the fact that the returns of workers are limited to those of 16 years and over. What proportion of the woollen and worsted population is omitted from these returns by the failure to include workers of 14 and 15 years of age? In the absence of detailed statistics concerning those below the insurable age, we may turn to the distribution of the juvenile population in the industry as it is recorded in the Industry Tables of the 1921 Census. The following table summarizes the position :—

	Total 14 years and over.	Total of ages 14 and 15.	Juveniles as percentage of whole.
270. Combing	11,549	74	0.64
271. Worsted spinning	48,098	8,354	17.4
272. „ weaving	53,526	4,095	7.6
273. Mungo making	6,151	150	2.4
274. Woollen manufacture ..	110,056	6,816	6.2
275. Felt manufacture ..	890	19	2.1
	230,270	19,508	8.5

These percentages will tend to understate the position now that the raising of the school-leaving age has compelled the recruitment of a larger number of workers of 14 and 15 years of age to compensate for the loss of the 12- and 13-year-old workers. The precise extent of this change we cannot record.

If we take the table as a guide to the proportion of the woollen and worsted population not accounted for by the Insurance returns for the industry, we must accept the warning that returns of insured workers cannot be pressed to give us a precise idea of the typical business. The numbers of juveniles attached to each firm are not recorded. Therefore, while we may reasonably infer that the inclusion of juveniles would affect the position of the larger businesses in the scale much more extensively than it would affect the small firms, we cannot be certain of the distribution of the juveniles over the firms, and must refrain from placing a "mode" or "modes" in the series recorded in the tables below.

The absence of the juvenile figures from the Insurance records is considered by many in the West Riding to be sufficient cause for a complete mistrust of the data either for the purposes of employment or for the measurement of unemployment. This extreme view is hardly justified. The tables set out below give us a far fuller picture of the economic life and organization of the wool textile industry than has been available before. It would be extravagant to claim that they give us material for a final analysis of the industry and a knowledge of the relative sizes of its parts. But they do shed considerable light on two or three questions of practical importance to the industry.

In Table II,* details are given of the distribution of all the firms investigated. Each firm is treated as a business unit and grouped according to its size in terms of operatives, irrespective of the actual process or processes to which it is devoted.

The most impressive feature of the table is the concentration of small firms at the head of the list. No fewer than 882 of the 1,384 firms recorded are within the range 1—100 operatives; Bradford, Huddersfield, and the two heavy-woollen towns—Dewsbury and Batley—are the largest contributors to this state of affairs. The addition of the juvenile figures would not be likely to lead to a large displacement among the smallest firms in the series. These facts bring us face to face with one of the most keenly debated problems of the industry—the existence of, and justification for, the

* In Tables II to VIII, Huddersfield includes Holmfirth, Meltham, Skelmanthorpe and Slaithwaite; Shipley includes Bingley; Leeds includes Armley; Otley includes Guiseley.

"small man." The boundary-line between small- and large-scale production is of necessity hard to define, but trade views are helpful, and we may work upon a widely accepted view that all firms of over 100 employees are in the realm of "bigger" firms. If we apply this distinction to the figures in Tables IV to VI, the dominant position of the smaller firm in each section of the industry is beyond question. In the list of combers, 47 out of 78 firms are below the 100 mark; in the list of spinners, 136 out of 262; and in the list of manufacturers, 443 out of 773. The groups, "Combing," and "Spinning," and "Manufacturing," must be taken to indicate that the firm in question proceeds as far as the process mentioned. Some spinners run a few combs, but not enough completely to feed their spindles. Some manufacturers may spin and weave, but also buy yarn from outside to feed their looms. In the heavy-woollen area the term "Manufacturer" usually means a firm starting with rags and finishing with cloth on the premises. But it frequently means a firm just grinding rags to "manufacture" shoddy or mungo, which is then passed forward as the raw material for the spinning and weaving processes. This absence of precise machinery combinations warns us against the attempt to define the business units in the industry in terms of the plant they employ. The widespread use of the commission system gives us the clue to the widely differing combinations of processes within the firms. Is it too much to hope that we should be able to secure, year by year, details of the numbers engaged by each firm on each of the different processes performed in its business?

In Table IV one may suspect the inclusion in the 1-20 group of a number of "top-makers without combs" who have been recorded as wool combers, and in a similar manner the 1-20 group on the "manufacturers" list may be held to include some quite small firms who describe themselves as manufacturers but who are, in reality, agents seeking orders which they place out to be manufactured on commission. They are the "manufacturers without looms."

These qualifications are not sufficient to invalidate the statement that the small firm is met with far more frequently than the large firm in the industry. But the larger firms employ a very high proportion of the operatives engaged, so that the bulk of the output of the industry may be said to be produced under conditions of large-scale manufacture. In the combing list the 31 firms over the 100 mark employ 7,160 workers as against the 1,830 employed by the 47 firms below the 100 level. Operatives employed by large spinners outnumber those employed by small firms by 5 to 1, and this

advantage would be emphasized if the figures for juveniles could be included.

In manufacturing, 443 small firms employ 17,310 workers as against 101,340 employed by the large firms, although in this case it is desirable to distinguish between the influence of specialization in Bradford worsted industry and the presence of the "all-in" type of firm in the woollen centres. From the Bradford and Huddersfield records it proved possible to separate manufacturers who weave only from those who combine other processes with their weaving. The results are set out in Table VII. These tables show that in Bradford the smaller weaving firms are not so heavily outweighed by the larger ones in terms of operatives. The 170 small firms employ 5,340 workers as against the 6,710 employed by the 37 large firms. Twenty-four of the 30 combined firms on the other hand are large concerns employing in all 9,810 workers as compared with the 160 in the smaller firms. The single-process firms weaving in Huddersfield are few in number, the town being characterized by the "all-in" type of woollen firms. Naturally the population of these firms is greater than that of the small firms. Seventy-eight of them over the 100 mark employ 23,270 workers, as compared with the 2,160 employed by the 38 firms below the 100 mark. In Dewsbury, Batley, and Morley area the operatives in the large firms outnumber those in the small firms by nearly 8 to 1.

Sufficient has been said to show that the woollen and worsted industry is like a jig-saw puzzle in appearance. The large firms are the large pieces covering the greatest area of the design. Tucked in between the large pieces there are many small, peculiarly shaped parts: the small firms that complete the design and bind the industry together. Whether these small firms are necessary or are economical in their working are questions that give rise to hot debate.

The existence of the small firm is largely the outcome of the system under which room and power can be rented, thus eliminating the necessity for raising sufficient capital to erect buildings before manufacture is begun. In the Bradford area, as in the North-East Lancashire cotton industry, many mills may be found to house several firms whose machinery is driven off the same engine; add to this facility for making a small start in business the opportunity to work on commission, and the entry of the small firm is complete. A popular customary argument in favour of the small man is, that the large variety of product required of the industry can only be maintained by the opportunity on the part of the larger merchant or manufacturer to have recourse to the looms or spindles of the small firm. But deeper down in the minds of those attached to the

industry is the belief that big businesses kill personal initiative and lead to burdensome monopolies. (Certainly there can be few trades in the country with a higher proportion of self-made men.

The corollary of the "variety of product" argument in favour of the small man would seem to be "mass production" by the large firms; but oddly enough, this is not the case, the big firms are often several small firms in one from the point of view of production. The few "vertical" combinations that exist are based on speciality productions, and "horizontal" combination is far more likely to occur than vertical in the future, despite the fact that the industry is frequently in conflict with the sectional combines in combing and dyeing. Standardization of products is seldom discussed, largely because of this belief that variety of production is the only hope of existence for an industry dependent upon the changes of fashion in dress.

It is difficult to see why the "variety of product" explanation has not produced highly specialized production in woollen manufacture. If it is true of worsted, why not of woollens, with the bewildering variety of rags for raw material? The answer appears to lie in the fact that the necessary variety can be secured for any given product in woollens by the initial "blending" process. In the production of worsted, the speciality of the product is maintained by specialization at each stage of manufacture, but it is always rather hard to see why the necessary degree of skill should not be achieved in top-making, spinning, and weaving within the bounds of one larger firm. The existence of some large combined firms in worsted manufacture certainly shows the possibility of this being done.

The existence of large-scale commission wool combing suggests one strong reason for the absence of vertical combinations on the worsted side of the industry. Wool-combing plant is expensive and would be a serious item to duplicate in every firm. The industry has cut this knot by the use of the premises and combs of the firm that specialize on combing on a commission basis, and they have grown in many cases to very considerable proportions. Their orders for combing may come from the wool merchant, the top-maker, or the spinner. Normally, this farming-out of a vital function works well, but in times of boom combing is a "bottle-neck," and at such times the bigger firms tend to contemplate vertical integration. The "spinner-comber" is on the increase, but it is much too soon to say that the worsted industry is moving definitely in the direction of vertical integration.

One other interesting aspect of the woollen and worsted industry is brought to light by the figures in the tables, namely, the existence

of the many "raggers" in the Dewsbury and Batley area. There are close on 200 of these small firms employing a few rag sorters (3 to 6 workers is quite a common type); they sort the rags and pass them forward to larger dealers, who in turn sell them to the woollen manufacturers. But often the small firm will run a rag-grinding machine and sell the mungo or shoddy to the manufacturer. Naturally one asks, Why so many tiny firms engaged on the task of assembling and sorting the rags? Could not the organization of the large dealer tap the sources of supply more economically than a multitude of small men? The technique of sorting offers no clue to the persistence of the small "ragger," for one has seen a large firm sorting every imaginable kind of rag into a large range of types. Once more one is compelled to fall back upon the argument of custom, and the force of the belief that the small firm discovers the skill of an individual in a way that the large concern can not. But the definite impression remains in one's mind that the many tiny rag firms can scarcely be economical as a method of feeding the low woollen industry with its raw materials.

A few words must be said about Table VIII. The distinction is drawn in this table between the "private" firm (P.) and the limited-liability or joint-stock company (J.S.). The totals indicate that the balance is still slightly in favour of the private firm in the West Riding. The private firm is commoner in the heavy woollen area than elsewhere. Bradford still has more private firms than joint-stock firms, but in Huddersfield joint-stock organization is, apparently, gaining the lead.

There have been two main incentives to the adoption of the limited-liability type in the industry. The first is the desire to confer upon a business a continuous type of organization provided by the existence of transferable shares of a known value; the second is the play of national taxation. Prior to the Finance Act of 1922, undistributed profits did not come within the purview of the super-tax. This fact tended to encourage the formation of private limited companies in which the profits were subject to income tax, but only so much of the profits as was actually distributed and paid was liable to super-tax. Consequently these companies declared little or no dividend, but put all the profit into reserve. This movement was stopped by the Finance Act of 1922, but it would be interesting to know how many companies were formed with this object in view.

To sum up: The study of the wool textile industry is seriously hampered by the lack of information about its raw materials,

its machinery, its production, and its trade. A limited amount of information about employment in the industry has been canvassed in this paper. While it is not difficult to imagine the reasons which account for the recording of official statistics by the Census and the Ministry of Labour on the basis of classifications that do not tally, it is a matter for regret that much valuable information is lost year by year from this cause; but even the incomplete information available enables us to gauge the industry more closely than has been possible hitherto. While it is an industry in which small firms are to be found in greater numbers than large firms, it is not, therefore, a small-scale industry. The greater part of its population is engaged in manufacture in large-scale businesses, and the joint-stock type of organization is slowly displacing the private firm.

Peculiar industrial conditions like the room and power system afford a place for the "small man," but whether he is vital to the industry or what economic forces are likely to displace him are questions that lie beyond the scope of this enquiry. The most urgent need of the moment is more information about the organization and trade conducted by the industry, and the goodwill of the many voluntary associations within the industry would carry us far towards this goal.

TABLE I.—*Numbers of Insured Persons in 1921 in the chief Trades in each of the Principal Textile Centres of the West Riding.*

BATLEY.		HUDDERSFIELD.	
<i>Total Insured population</i>	.... 15,103	<i>Total Insured population</i>	.... 53,177
Woollen and worsted	.... 9,669	Woollen and worsted	.... 24,139
Coal-mining	.... 2,539	General engineering	.... 5,629
		Distributive trades	.... 3,610
		Chemicals	.... 3,112
		Building	.... 2,205
		Tailoring	.... 2,002
		Gas, water, electricity	.... 1,484
		Cotton industry	.... 1,385
		Textile bleaching and dyeing	.... 1,081
BRADFORD.		KEIGHLEY.	
<i>Total Insured population</i>	.... 122,176	<i>Total Insured population.</i>	.... 18,884
Woollen and worsted	.... 63,490	Woollen and worsted	.... 7,622
Distributive trades	.... 11,303	General engineering	.... 5,107
Textile bleaching and dyeing	.... 8,452		
Local government	.... 6,493		
General engineering	.... 4,786		
Building	.... 3,871		
Silk	.... 2,083		
Printing	.... 1,857		
BRIGHOUSE.		LEEDS.	
<i>Total Insured population</i>	.... 9,166	<i>Total Insured population</i>	.... 127,740
Woollen and worsted	.... 1,253	Tailoring	.... 27,808
General engineering	.... 1,187	General engineering	.... 16,499
Cotton industry	.... 1,009	Distributive trades	.... 14,609
Carpet industry	.... 955	Building	.... 6,232
Textile bleaching and dyeing	.... 787	Woollen and worsted	.... 5,201
		Printing	.... 4,989
		Puddling furnaces, iron and steel working	.... 3,148
		Hotel service	.... 2,666
		Coal-mining	.... 2,447
		Boot and shoe	.... 2,368
		Furniture	.... 1,987
		Public works contracting	.... 1,929
		Textile bleaching and dyeing	.... 1,545
DEWSBURY.		ARMLEY.	
<i>Total Insured population</i>	.... 20,354	<i>Total Insured population</i>	.... 14,963
Woollen and worsted	.... 11,607	Woollen and worsted	.... 3,223
Coal-mining	.... 2,137	Railway-carriage building	.... 1,363
		General engineering	.... 1,308
		Tailoring	.... 1,149
		Distributive trades	.... 1,091
HALIFAX.		SPEN VALLEY.	
<i>Total Insured population</i>	.... 39,373	<i>Total Insured population</i>	.... 17,350
Woollen and worsted	.... 11,944	Woollen and worsted	.... 4,916
General engineering	.... 4,833	Carpet industry	.... 2,055
Distributive trades	.... 2,564	General engineering	.... 2,019
Carpet industry	.... 2,373	Wire, wire-netting	.... 1,618
Building	.... 1,354	Coal-mining	.... 1,038
Cotton industry	.... 1,189	Textile bleaching and dyeing	.... 680
Saddlery	.... 1,169		
Textile bleaching and dyeing	.... 1,084		
HEBDEN BRIDGE.			
<i>Total Insured population</i>	.... 6,372		
Tailoring	.... 2,433		
Cotton industry	.... 1,858		
Textile bleaching and dyeing	.... 449		
Woollen and worsted	.... 339		

TABLE I—*continued.*

MORLEY.		SOWERBY BRIDGE.— <i>contd.</i>	
<i>Total Insured population</i>	.... 14,707	Carpet industry	.... 549
Woollen and worsted	.... 7,715	Textile bleaching and dyeing	413
Coal-mining	.... 2,638		
SHIPLEY.		STANNINGLEY.	
<i>Total Insured population</i>	.... 14,751	<i>Total Insured population</i>	.... 14,782
Woollen and worsted	.. 9,382	Woollen and worsted	.... 9,697
Building	.... 1,179	General engineering	.... 1,318
General engineering	.... 874		
SOWERBY BRIDGE.		WAKEFIELD.	
<i>Total Insured population</i>	.. 11,011	<i>Total Insured population</i>	.... 27,967
Woollen and worsted	.. 4,049	Coal-mining	.... 9,931
Cotton industry	.... 2,810	Woollen and worsted	.... 4,396
General engineering	.... 588	General engineering	.... 2,491
		Local government	.... 1,767
		Distributive trades	.... 1,330
		Railway-carriage building	.... 1,207

TABLE II.—*Distribution of Firms in the Woollen and Worsted Industries (all processes).*

Operatives.	Bradford.	Hudders- field.	Halifax.	Shipley.	Stanningley.	Keighley.	Leeds.	Spenn Valley.	Wakefield.	Sowerby B.	Otley.	Brighouse.	Dewsbury.	Batley.	Morley.	Total.
1—20...	122	60	2	3	16	6	7	4	1	...	2	1	49	93	17	380
21—40...	58	30	12	11	7	11	10	3	1	...	2	...	20	10	8	183
41—60...	52	15	8	10	11	6	8	4	1	...	2	...	6	5	8	137
61—80...	26	11	6	9	9	6	3	4	4	...	1	...	9	4	7	93
81—100...	28	13	6	8	9	6	1	1	2	...	1	...	7	4	5	89
101—120...	28	10	7	7	1	7	3	4	1	...	2	...	3	3	4	84
121—140...	13	7	5	2	8	4	6	4	...	...	1	...	3	2	9	63
141—160...	14	8	3	1	3	4	3	4	...	...	...	...	3	1	2	45
161—180...	15	10	1	2	4	...	4	1	2	...	...	...	2	3	5	47
181—200...	10	5	3	2	2	2	2	1	2	...	...	...	3	3	2	41
201—220...	7	4	3	2	2	1	2	1	...	...	...	...	2	1	1	25
221—240...	5	3	...	1	2	...	...	1	...	...	1	...	...	2	2	16
241—260...	9	3	1	3	2	1	1	...	1	...	...	...	1	1	...	23
261—280...	4	4	2	...	1	3	1	...	1	...	...	...	...	...	...	19
281—300...	2	2	...	2	1	1	1	...	1	...	...	...	1	...	...	11
301—320...	2	3	...	1	1	1	1	...	1	...	2	...	...	1	1	15
321—340...	1	3	...	...	1	...	2	1	...	...	...	...	...	...	1	9
341—360...	1	3	...	...	1	...	1	...	...	...	1	...	...	1	1	8
361—380...	2	4	...	...	...	...	...	2	...	...	1	...	1	...	1	10
381—400...	2	...	...	1	...	1	...	1	...	1	...	...	2	1	1	6
401—420...	2	2	...	1	...	...	...	1	...	...	...	...	...	...	...	8
421—440...	3	1	...	...	...	...	1	...	1	...	...	...	...	...	...	3
441—460...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	5
461—480...	...	3	...	...	...	...	...	...	1	...	...	...	...	...	...	9
481—500...	...	1	...	...	...	...	...	...	1	...	1	...	1	1	1	4
501—600...	3	1	1	...	...	...	...	1	...	...	1	...	...	...	...	10
601—700...	2	2	1	...	...	...	...	...	...	...	...	...	...	...	...	9
701—800...	3	3	2	1	2	...	1	...	...	...	...	...	...	...	...	11
801—900...	2	1	...	1	1	...	...	...	1	...	...	...	...	...	...	4
901—1000...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2
1001 >...	4	3	1	1	...	1	...	...	...	...	...	...	2	2	...	14
Total	418	217	64	70	76	61	58	32	21	20	18	6	112	139	72	1,384

TABLE III.—*Summary of Firms engaged in different branches of Woollen and Worsted Industry. (West Riding.)*

	Combing.	Spinning.	Manufacturing.	Other processes.	Total.
Bradford	68	87	237	26	418
Huddersfield	1	37	157	22	217
Halifax	2	27	33	2	64
Shipley	6	7	42	15	70
Stanningley ....	...	13	55	8	76
Keighley	1	33	25	2	61
Leeds ...	...	5	53	...	58
Spen Valley ....	...	17	15	...	32
Wakefield ....	...	10	8	3	21
Sowerby Bridge ....	...	12	8	20	20
Otley ....	...	1	16	1	18
Brighouse ....	...	3	2	1	6
Dewsbury ....	...	5	38	69	112
Batley ....	...	2	36	101	139
Morley ....	...	3	48	21	72

TABLE IV.—*Combers.*

Operatives.	Bradford.	Huddersfield.	Halifax.	Shipley.	Keighley.	Total
1— 20....	19	...	...	...	...	19
21— 40....	4	...	2	...	...	6
41— 60....	11	1	...	...	...	12
61— 80....	1	...	...	1	...	2
81— 100....	7	...	...	1	...	8
101— 120....	4	...	...	...	1	5
121— 140....	5	...	...	1	...	6
141— 160....	2	...	...	...	...	2
161— 180....	3	...	...	...	...	3
181— 200....	...	...	...	...	...	...
201— 220....	1	...	...	...	...	1
221— 240....	1	...	...	1	...	2
241— 260....	4	...	...	1	...	5
261— 280....	1	...	...	...	...	1
281— 300....	...	...	...	1	...	1
301— 320....	...	...	...	...	...	...
321— 340....	1	...	...	...	...	1
341— 360....	1	...	...	...	...	1
361— 380....	...	...	...	...	...	...
381— 400....	...	...	...	...	...	...
401— 420....	1	...	...	...	...	1
421— 440....	...	...	...	...	...	...
441— 460....	...	...	...	...	...	...
461— 480....	...	...	...	...	...	...
481— 500....	...	...	...	...	...	...
501— 600....	1	...	...	...	...	1
601— 700....	...	...	...	...	...	...
701— 800....	...	...	...	...	...	...
801— 900....	...	...	...	...	...	...
901— 1000	...	...	...	...	...	...
1001 <	1	...	...	...	...	1
Total	68	1	2	6	1	78

TABLE V.—*Spinners.*

Operatives.	Bradford.	Hudders- field.	Hallifax.	Shipley.	Stanningley.	Keighley.	Leeds.	Spenn Valley.	Wakefield.	Gowdery B.	Otley.	Brighouse.	Jewsbury.	Batley.	Morley.	Total.
1—20...	8	13	...	...	2	2	2	...	1	...	...	...	...	1	...	29
21—40...	10	9	3	...	...	2	1	1	1	1	...	...	...	1	...	30
41—60...	12	3	1	...	3	2	1	3	3	1	...	...	...	...	...	27
61—80...	10	3	2	1	...	5	...	2	1	2	...	...	...	...	...	26
81—100...	6	2	1	1	...	5	...	1	1	3	...	...	...	...	...	24
101—120...	8	2	5	...	...	3	1	3	...	...	...	...	...	...	...	24
121—140...	5	2	3	1	1	3	...	1	...	...	...	1	...	...	...	15
141—160...	2	1	1	...	2	3	...	...	...	...	...	...	...	...	...	9
161—180...	4	...	1	...	...	3	...	...	2	...	...	...	...	...	...	7
181—200...	3	...	3	...	1	2	...	1	...	...	...	...	...	...	...	13
201—220...	3	...	3	...	1	2	...	...	...	...	...	...	...	...	...	6
221—240...	4	...	2	1	1	1	...	1	...	1	...	...	...	...	...	3
241—260...	2	...	1	...	...	1	...	...	1	...	...	...	...	...	...	3
261—280...	1	...	2	...	...	2	...	...	...	1	...	...	...	...	...	6
281—300...	1	1	...	...	...	1	...	...	...	...	...	...	...	...	...	2
301—320...	2	...	...	1	1	1	...	...	...	...	...	...	...	...	1	6
321—340...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	2
341—360...	...	...	...	...	1	...	...	2	...	...	...	...	...	...	...	4
361—380...	1	1	...	...	1	...	...	...	...	1	...	...	...	...	...	7
381—400...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2
401—420...	1	...	...	1	...	...	...	...	...	...	...	...	1	...	...	2
421—440...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	2
441—460...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3
461—480...	...	1	...	...	...	...	...	...	...	1	1	...	...	...	1	3
481—500...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...	2
501—600...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
601—700...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	1
701—800...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	3
801—900...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3
901—1000...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2
1001 < ...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	2
Total	87	37	27	7	13	33	5	17	10	12	1	3	5	2	3	262

TABLE VI.—*Manufacturers.*

Operatives.	Bradford.	Hudders- field.	Hallifax.	Shipley.	Stanningley.	Keighley.	Leeds.	Open Valley.	Wakefield.	Gowdery B.	Otley.	Brighouse.	Dewsbury.	Batley.	Morley.	Total.
1—20...	82	28	2	3	7	2	5	4	...	...	2	...	6	3	...	144
21—40...	40	19	7	5	7	9	9	2	...	1	...	...	3	2	5	109
41—60...	27	12	5	7	8	3	7	1	...	...	1	...	2	4	7	84
61—80...	15	7	4	7	9	1	3	2	...	...	1	...	2	...	6	57
81—100...	12	11	2	3	3	1	3	...	1	1	2	...	2	3	5	49
101—120...	14	8	2	3	1	3	3	1	1	1	2	...	2	4	5	48
121—140...	3	6	2	3	7	1	5	3	...	...	1	...	5	4	4	41
141—160...	8	7	2	...	1	1	3	...	...	2	...	...	3	1	2	31
161—180...	6	10	1	2	1	...	2	1	2	1	...	...	2	1	2	33
181—200...	7	5	1	2	3	...	2	...	...	...	1	...	1	3	5	29
201—220...	2	4	1	2	1	...	2	...	...	...	1	...	1	2	1	15
221—240...	1	3	...	2	...	...	...	...	...	2	1	...	1	1	2	9
241—260...	2	3	...	2	2	1	1	...	...	...	...	...	1	1	...	15
261—280...	2	4	...	1	1	1	1	...	1	...	...	1	1	2	...	12
281—300...	2	1	...	1	1	...	1	...	...	...	2	...	1	1	...	8
301—320...	...	3	...	...	...	...	1	...	...	...	...	...	...	...	...	9
321—340...	...	3	...	...	...	...	2	...	...	...	1	...	...	1	1	6
341—360...	...	3	...	...	...	...	1	...	...	...	...	...	...	1	...	6
361—380...	1	3	...	...	...	...	...	...	...	...	...	...	...	...	1	4
381—400...	2	...	...	...	...	...	...	1	...	...	...	...	...	1	1	7
401—420...	1	2	...	...	...	1	...	...	...	...	...	...	...	1	...	6
421—440...	2	1	...	...	...	...	1	...	...	...	...	...	...	...	...	3
441—460...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	4
461—480...	...	3	...	...	...	...	...	...	1	...	1	...	...	...	...	3
481—500...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1
501—600...	2	1	...	...	...	...	...	...	...	...	1	...	1	1	1	7
601—700...	1	2	1	...	...	...	...	...	...	...	...	...	1	...	...	8
701—800...	3	3	1	2	2	...	...	...	...	1	...	...	...	...	...	10
801—900...	...	1	1	1	1	...	1	...	...	...	...	...	...	...	...	1
901—1000...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1001 > ...	2	3	...	1	...	1	...	...	...	...	...	...	2	...	...	11
Total	237	157	33	42	55	25	53	15	8	8	16	2	38	36	48	773

TABLE VII.—*Manufacturers.*

Operatives.	WEAVING ONLY.		COMBINED PROCESSES.	
	Bradford.	Huddersfield.	Bradford.	Huddersfield.
1— 20	79	24	3	4
21— 40	39	13	1	6
41— 60	25	....	2	12
61— 80	15	2	....	5
81— 100	12	....	....	11
101— 120	13	1	1	7
121— 140	3	....	....	6
141— 160	4	....	4	7
161— 180	4	....	2	10
181— 200	3	....	4	5
201— 220	2	....	....	4
221— 240	1	....	....	3
241— 260	2	....	....	3
261— 280	1	....	1	4
281— 300	1	....	1	1
301— 320	....	1	....	2
321— 340	....	....	....	3
341— 360	....	....	....	3
361— 380	1	....	....	3
381— 400	....	....	2	....
401— 420	....	....	1	2
421— 440	1	....	1	1
441— 460	....	....	....	1
461— 480	....	....	....	3
481— 500	....	....	....	....
501— 600	1	....	1	1
601— 700	....	....	1	2
701— 800	....	....	3	3
801— 900	....	....	....	1
901— 1000	....	....	....	....
1001 <	....	....	2	3
Total	207	41	30	116

TABLE VIII.—*Private and*

Operatives.	Totals.		Bradford.		Hudders- field.		Halifax.		Shipley.		Stanning- ley.		Keighley	
	J.S.	P.	J.S.	P.	J.S.	P.	J.S.	P.	J.S.	P.	J.S.	P.	J.S.	P.
1— 20 ...	49	331	13	109	5	55	1	1	1	2	4	12	3	3
21— 40 ...	64	119	18	40	12	18	4	8	5	6	2	5	7	4
41— 60 ...	62	75	17	35	11	4	4	4	6	4	4	7	4	2
61— 80 ...	44	49	11	15	9	2	2	4	4	5	6	3	3	3
81— 100 ...	49	40	15	13	9	4	3	3	3	5	2	1	2	4
101— 120 ...	42	42	12	16	6	4	5	2	3	4	1	...	4	3
121— 140 ...	38	25	8	5	6	1	4	1	1	1	3	5	1	3
141— 160 ...	32	13	10	4	4	4	1	2	1	...	3	...	4	...
161— 180 ...	29	18	11	4	4	6	1	...	1	1	2	...	...	...
181— 200 ...	22	19	4	6	4	1	1	2	1	1	1	3	2	...
201— 220 ...	17	8	5	2	3	1	2	1	1	1	1	1	...	...
221— 240 ...	13	3	2	3	3	...	...	...	1	...	...	...	1	...
241— 260 ...	20	3	5	1	3	...	...	1	3	...	2	...	1	...
261— 280 ...	12	7	2	2	3	1	1	1	...	...	1	...	1	2
281— 300 ...	8	3	1	1	1	1	...	...	2	...	1	...	1	...
301— 320 ...	9	6	1	1	2	1	...	...	1	...	1	...	1	...
321— 340 ...	8	1	...	1	3	...	...	...	...	...	1	...	...	...
341— 360 ...	6	2	1	...	2	1	...	...	...	...	1	...	...	...
361— 380 ...	9	1	1	1	4	...	...	...	...	...	...	...	...	...
381— 400 ...	3	3	...	2	...	...	...	...	1	...	...	...	...	...
401— 420 ...	7	3	...	2	2	...	...	...	1	...	...	...	1	...
421— 440 ...	5	3	2	1	1	...	...	...	...	...	...	...	...	...
441— 460 ...	2	1	...	...	1	...	...	...	...	...	...	...	...	...
461— 480 ...	4	1	...	...	3	...	...	...	...	...	...	...	...	...
481— 500 ...	3	1	...	...	1	...	...	...	...	...	...	...	...	...
501— 600 ...	9	1	2	1	1	...	1	...	...	...	...	...	...	...
601— 700 ...	9	...	2	...	2	...	1	...	2	...	2	...	...	...
701— 800 ...	11	...	3	...	3	...	2	...	1	...	1	...	...	...
801— 900 ...	4	...	2	...	1	...	...	...	...	...	...	...	...	...
901—1000 ...	2	...	1	...	1	...	...	...	...	...	...	...	...	...
001< ...	11	3	3	1	2	1	1	...	1	...	...	...	...	1
Totals	603	781	152	266	112	105	34	30	39	31	39	37	36	25
	1384		418		217		64		70		76		61	

Joint-Stock Companies.

Leeds.		Spen Valley.		Wakefield.		Sowerby Bridge.		Otley.		Drighouse.		Dewsbury.		Batley.		Morley.	
J.S.	P.	J.S.	P.	J.S.	P.	J.S.	P.	J.S.	P.	J.S.	P.	J.S.	P.	J.S.	P.	J.S.	P.
3	4	2	2	....	1	..	....	....	2	....	1	6	40	8	85	3	14
3	7	1	2	....	1	2	....	....	....	....	....	5	15	4	6	1	7
6	2	....	4	....	1	1	....	1	1	....	..	1	5	3	2	4	4
2	1	2	2	....	4	....	....	....	....	....	....	3	3	....	1	2	5
1	....	1	....	....	2	3	....	....	1	1	....	4	3	3	1	3	2
1	2	3	1	....	1	4	....	....	2	....	....	1	2	1	1	1	4
3	3	3	1	....	....	....	....	....	....	....	....	4	1	3	2	2	2
2	1	....	....	....	....	2	....	....	1	....	....	3	....	....	1	2	....
1	3	1	....	....	2	1	....	....	....	....	....	....	2	2	....	5	....
2	....	1	....	....	2	....	1	....	....	1	....	1	2	2	1	2	....
2	....	....	....	....	1	....	....	....	....	....	....	1	1	1	....	....	1
....	....	1	....	....	....	....	....	1	....	....	....	....	....	2	....	2	....
1	....	....	....	....	1	2	....	....	....	1	....	1	....	1	....	....	....
....	1	....	....	....	....	1	....	....	....	1	....	....	....	2	....	....	....
1	....	....	....	....	1	....	....	....	....	....	....	1	....	....	....	....	....
1	....	....	....	....	1	....	....	....	1	1	....	....	....	1	....	....	1
2	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....
1	....	....	....	....	....	....	....	....	1	....	....	....	....	1	....	....	....
....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....
....	....	1	....	....	....	1	....	....	....	....	....	1	....	1	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	1	1	1	....	1	....
1	....	....	....	....	1	....	....	1	1	....	....	....	....	....	....	....	....
....	....	....	....	....	1	....	....	1	....	....	....	....	....	....	....	....	....
....	....	....	....	....	1	1	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	1	....	....	....	....	1	....	....	1	....
....	....	1	....	....	....	....	....	1	....	....	....	1	....	1	....	1	....
1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	....	2	....	2	....	....	....
34	24	20	12	1	20	19	1	7	11	4	2	36	76	39	100	32	40
58		32		21		20		18		6		112		139		72	

TABLE IX.—*Actual Numbers of Operatives engaged in each of the Groups shown in TABLE II.*

Operatives.	Number of Firms.	Actual Totals.
1— 20	380	3,718
21— 40	183	5,402
41— 60	137	6,630
61— 80 .. .	93	6,562
81— 100	89	7,922
101— 120	84	9,098
121— 140	63	8,294
141— 160	45	6,706
161— 180	47	8,072
181— 200 . . .	41	8,014
201— 220	25	5,243
221— 240	16	3,680
241— 260	23	5,794
261— 280 . . .	19	5,178
281— 300	11	3,212
301— 320 . . .	15	4,658
321— 340	9	2,977
341— 360	8	2,829
361— 380	10	3,683
381— 400	6	2,339
401— 420	10	4,116
421— 440	8	3,458
441— 460	3	1,336
461— 480	5	2,346
481— 500	4	1,953
501— 600	10	5,350
601— 700	9	5,809
701— 800	11	8,308
801— 900	4	3,425
901—1000	2	1,869
1000<	14	19,688
Total	1,384	167,669

PROCEEDINGS OF THE MEETING.

For the first time during the ninety-one years of its existence the Royal Statistical Society held, on December 16, 1925, a meeting outside London. This took place at the Leeds University.

A reception was held during the afternoon by the Vice-Chancellor of the University (Dr. J. B. Baillie) in the Great Hall, and afterwards a general meeting was held in the Chemical Theatre. The Chair was occupied by the President, Mr. G. Udny Yule, F.R.S., who was supported by the Vice-Chancellor and by Mr. A. W. Flux, Honorary Secretary of the Society. The Vice-Chancellor, on behalf of the University, offered the Statistical Society a warm welcome.

This was, he understood, not merely the first visit of the Society to Leeds, but the first time in the long history of the Society that they had met outside London. He appreciated that as a compliment, and he trusted that it would not be the only occasion when they would visit Leeds, which was, of course, the most important city in the universe! The Society's work was most valuable, for there was no department of science which did not depend upon numbers, or could get very far without accurate statistics. It was a curious fact, which he had only learned that day, that the word "statistics" originally meant the sort of information given in the "Statesman's Yearbook," because the word had an etymological association with the community of the State; everyone's interests were accordingly connected in some degree with statistical science. He understood that some people regarded it as a "dismal science," but so far as he could make out from the faces of those present the students of statistics seemed to be cheerful people. He repeated that in the future the Society would always receive a warm and hearty welcome in Leeds. The University was doing its best to take an interest in the scientific study of statistics, which the Society existed to encourage.

The PRESIDENT, on behalf of the Society, rendered most hearty thanks to the Vice-Chancellor for his kind hospitality offered to the Society in the opportunity given them for that meeting at the University. It was really an historic occasion in the Society's proceedings, because it was the first occasion of its meeting outside the place of its birth. He hoped and believed that it marked a new era in the development of its activities. If that was the first meeting to be held outside London, assuredly it would not be the last, nor even the last meeting to be held in Leeds. There had been a great and an increasing interest in statistics and the statistical method of study in the last twenty years or so. About half a century ago there was no instruction given in any place in the United Kingdom in statistical methods. With further development such instruction became urgently necessary, and it had been taken up in some of the Universities, among which he was glad to put the name of the University of Leeds. In a very small way he had been associated with that work in the University, mainly in the minor and somewhat terrifying capacity of examiner, and it had given him great pleasure that the first provincial meeting to be held should be at the University of Leeds. Not long ago the Society had the honour of sending a delegate to the University of Leeds to present an address on the occasion of the University's coming-of-age celebrations. Their delegate on that occasion was Dr. Dudfield, whom he regretted to say was no longer with them. He hoped that when the University next held such a celebration in its reverend and prosperous age the delegate of their Society would feel that he was not going among strangers, but was visiting friends and fellows in another home of the Society.

The Vice-Chancellor having retired, the PRESIDENT announced the receipt of letters of apology from Professor J. H. Jones, Professor of Economics in the University of Leeds, and from Colonel the Hon. F. Vernon Willey, Chairman of the Wool Textile Delegation.

DISCUSSION ON MR. SHIMMIN'S PAPER.

Mr. A. W. FLUX, in moving a vote of thanks to Mr. Shimmin for his paper, said that the Council of the Royal Statistical Society had delegated to the longest in service of its honorary secretaries the moving of a vote of thanks. In doing this, it desired to express its appreciation of the paper and of its great interest in the experiment with which that paper was associated, viz., the holding of meetings outside the limits of London. It was to him a great personal pleasure to undertake this function. Mr. Shimmin had, above all things, stressed in various parts of his paper the need for more statistical information about our leading industries. He had dealt particularly with one of these industries, but there were several others of at least comparable importance in the life of the community about which the same fact was true, that we are groping in lamentable darkness because the need of scientific and carefully compiled statistics had not been adequately appreciated. Too often such information could not be got because the necessary records were not kept in time. What they could determine was not to allow any more time to pass without setting to work to provide an adequate structure of statistical information about the great industries. It was worth while reflecting upon the sad lack of information about the past, and there were two things in regard to the future to which he felt tempted to refer in this connection, directly moved to that by the subject and language of Mr. Shimmin's paper. One was the Census of Production. In regard to that, the reports he had from his staff indicated that the woollen and worsted industries had played up very well indeed compared with most of the industries in responding to the request for information conveyed by the issue of the Census schedules earlier in the year. He would like to ask those who had not yet dealt with that request—and there were a certain number of such cases—to deal with it without delay. They might be receiving a reminder from the Board of Trade before very long. He would be personally indebted to them as the official in charge, and they would contribute to their country's welfare if they attended to that reminder. When the officials had cleared their minds of the anxiety as to whether they had got the full information they would be able to get on with their work of computing the totals of the different classes—woollen and worsted textiles, apparel, engineering and so forth. He stressed this appeal to the industries to give a return as soon as possible if a return was properly due, and to tell them if they had made any mistakes in issuing schedules to firms not liable to furnish a return. A good deal had been changed

since the last Census of Production. Industry had been turned topsy-turvy by the war, and he asked firms to have as much sympathy with the officials conducting the new Census as possible. They recognized that they were liable to mistakes and they asked all good citizens to help them as quickly as they reasonably could.

He regretted the absence of Sir Josiah Stamp, who had talked about the need of an Index of Productive Activity for this country. He was absolutely in agreement with Sir Josiah in believing that such an index needed to be constructed. But it would only be constructed by the growth of that spirit which Mr. Shimmin urged—a willingness on the part of the heads of industry to contribute information. It was by no means improbable that, as soon as they got guidance from the returns of 1924, they might invite assistance from the leaders of industry to enable them to compile an Index of Productive Activity of this country which would be better than anything that could be prepared from the information at present available. He was grateful to those who had given information, and Mr. Shimmin's paper showed the kind of figures which were possible of access. He hoped this paper would induce those who had heard it or who might read it to lend their assistance to the efforts to which he had referred.

In reference to a point raised in the paper, he hoped that the summarized returns of the Census of Production of 1924 would give a skeleton summary of the largest industries of the West Riding which would be of value and might to some extent begin to meet one of the laments of Mr. Shimmin in his survey of the figures at present available.

He would like to say how good it was to have keen and accurate writers collecting information of the character embodied in Mr. Shimmin's paper. In the main the information dealt with was information which, in its original compilation, had not the public need for statistics in view at all. The Labour Exchanges drew up their lists for the information of their own officials, so that they might be able the more efficiently to place applicants for employment. It was proper to remember this fact in view of the question raised by Mr. Shimmin that the classifications used by the Census authorities and those used by the Ministry of Labour were not identical. For the purpose for which the lists were made the question of comparability with other information did not arise. The primary object of the Labour Exchanges was to place men in employment, and their lists were framed to facilitate dealing with individual applications for work which an applicant could do, and this was quite different from the object of getting a clear idea of the industrial structure of Yorkshire and of the country. There was the further point that where there were two classifications it was important to see that they were not mixed, and he was not certain that they were not sometimes mixed in the paper. He had the honour of presiding over the Committee which drew up the Classification adopted in the Census. They had two definite objects in view and

they had two difficulties. One was the grouping of persons, whatever their occupation, in the category of workers with which they were associated for the moment. An invoice-clerk was quite capable of being employed in a dozen industries; a carman could carry woollen goods or machinery or anything one asked him to carry. These were not specialized industries, but the workers were for the moment attached to an individual industry. The Census aimed at getting a cross-section of the industry of the country at an actual moment, and of finding out how many people were in unspecialized processes in connection with each industry. In the earlier Census returns occupation stood in the foreground. In the building industry, for instance, bricklayers, masons, carpenters and so forth, wherever they were employed, were grouped with the building occupations, and the building industry in the returns of the Census of 1901 was an aggregate of this kind. In 1911 attention was given to seeing that such workers were enumerated under the industrial group to which they were attached, and in 1921 this was done more systematically. On this point he would like to read a letter from Mr. John Hilton, who regretted that it was impossible for him to be present at that meeting. Mr. Hilton's comments relate chiefly to the parts of the paper in which Mr. Shimmin refers to the classifications of workpeople used by the Ministry of Labour. He says:—

“In these references Mr. Shimmin appears to be confusing two quite separate and distinct classifications: (1) the industrial classification used solely for compiling the statistics of unemployment in insured industries, and (2) the occupational classification used solely for placing persons in employment.

“Mr. Shimmin quotes me, and correctly quotes me, as saying in March, 1923:—

‘It may be possible in the future to substitute for the present industrial code of the Ministry of Labour one of more commendable structure, preferably one coincidental, as far as possible, with the industrial code adopted in connection with the 1921 Census of Population.’

and he quotes me further as elaborating the point in the discussion which took place on the same occasion.

“Mr. Shimmin has, however, overlooked the point that what I said related solely to the *industrial* classification used in connection with unemployment insurance statistics, and, in consequence, his comments upon the classification question are likely to be misunderstood. At the date at which I was speaking, the industrial classification in use was one built up piecemeal as a result of successive extensions of the scope of the Unemployment Insurance Acts, which was far from commendable either in principle or arrangement. Three months after the giving of my paper, an entirely new industrial classification was introduced, framed on lines almost identical with those adopted for the industrial classification of the 1921 Census of Population. Mr. Shimmin's paper does not make it clear that the

change foreshadowed by me actually took place, and that, as a result, since 1923 the industrial statistics of unemployment in insured industries have been as nearly comparable as it is humanly possible to make them with the Census tabulations.

"Mr. Shimmin's paper gives the impression that I was contemplating in May, 1923, and that we are still contemplating, the substitution of the Census *occupational* classification for the occupational classification in use for placing purposes at Employment Exchanges. That change has never been in question. The occupational classification used at Employment Exchanges is specially designed for a particular administrative purpose. It has the merit, as Mr. Shimmin rightly says, of following fairly closely the actual sequence of processes as one finds them referred to most frequently in industry. The Census classification has been designed to serve a wide range of purposes: the Employment Exchange classification is primarily intended for one purpose—the placing of workpeople—and everything else must be subordinated to that.

"It would be from some points of view useful if the occupational record of persons registered for work at Employment Exchanges could be made comparable with the Census occupational classification, but these unemployment statistics are a by-product of the workings of a vast administrative machine, and where, as in this case, the obtaining of statistics in modified form would inevitably impair the efficiency of the administration, statistical considerations must take a second place.

"As regards the areas into which the occupational figures for the woollen industry are given in each issue of the *Ministry of Labour Gazette*, I should like to say that there would be no difficulty in adopting Mr. Shimmin's suggestion for giving the figures separately for all the principal centres of the industry. The information, when we begin to compile it, relates to the separate Employment Exchange centre. We have, however, to keep a very strict eye on the space available in the *Labour Gazette*, and we could not go into greater local detail in regard to the woollen and worsted industry without throwing the article relating to that industry out of scale with the articles devoted to other industries. To go into local detail for all the industries with which we deal would take up very much more space than we have available. It is this very practical consideration which compels us to our present course.

"I am very sorry not to be able to be present to say this in person and to express my general appreciation of Mr. Shimmin's paper. It is particularly gratifying to those responsible for improving the informational value of official statistics to find the results of their efforts turned to useful account."

Mr. Flux, continuing, said that the areas of the Population Census and the unemployment lists differed. Mr. Shimmin had pointed that out. In the early days the scope and work of the Labour Exchanges were very limited. They had regard to employment in a certain range only. The scope had since

been enormously extended and this had led to some modifications in the original scheme. The Employment Exchanges were in the same position as many firms. If they were replanning and rebuilding their factories they would alter things considerably, but they had factories and machinery already in existence and they were not prepared to scrap them. That, perhaps, was the situation with the Employment Exchanges in some respects, both in certain features of the classifications and in certain features of the areas. For instance, the area for which the Census of Population provided statistics was the county borough, but it was not the Employment Exchange area, and therefore the figures must not be expected to be identical. Mr. Shimmin had referred to another particular defect of information. The figures in the reports of the Population Census relating to the woollen and worsted industries did not show how many belonged to the combing section, how many to spinning, how many to weaving, and it did not quite correspond with Mr. Shimmin's classification. If he understood correctly, Mr. Shimmin made the latest process which took place in a factory the basis of his classification, not the dominant process. If a firm sorted wool, combed it, spun it, and also bought some yarns and wove cloth, he classed it as a weaving firm. In that way they had a weaving firm employing sorters. The occupation of wool-sorting was shown in actual figures in the occupational classification. The fact was that there was nothing to prevent one firm conducting two or three different industries, and this was a complex feature of the industries of Yorkshire which rendered the textile industry figures very difficult indeed.

Mr. H. SUTCLIFFE SMITH (Bradford Dyers' Association) seconded the resolution of thanks. He said he had great admiration for the work which Mr. Shimmin had already done, and he appreciated the fact that this paper had involved an enormous amount of work. Mr. Shimmin had built up his case with the very few figures available, and this was all the more credit to him. He had made very good bricks with very little straw and had clearly shown the paucity of available statistics. Another point, also, he had brought out well, namely, the great number of small firms engaged in the trade. That was quite correct: the number of firms in the trade was certainly amazing. But he himself believed that the future of the trade of Great Britain would be more and more with the big business concerns rather than with a multiplicity of small businesses. All those engaged in business were rather at sea at times for want of statistics, and were often like a ship without a rudder. He was faced with the same difficulties as Mr. Flux in the matter of getting correct information and of ascertaining stocks. All those like himself engaged in trade needed, very badly, clear and accurate statistics so that they might judge both the home and the foreign trade. It was the uncertainty of the position which made business very difficult. They needed statistics of the volume of trade in the different branches so that they might know whether they themselves were getting their

share, whether they were gaining or losing in proportion to the trade as a whole. This knowledge was of great importance to them in telling whether they ought to cut prices or not. Many people cut prices when trade fell off without knowing whether or not they were getting their due proportion, and because they feared that they were losing ground. That only made the position worse. In this country there were two trades which seemed to have proper statistics—the coal and the steel trades. The information available enabled one to arrive at the coal position quite accurately. He was interested in the dye-ware trade, for, as some present knew, he was Chairman of the Colour Users' Association. In that position he had been agitating for accurate records of what British dye-makers were producing. At present they had no figures. They were called upon to pay for the establishment of a British trade, but they had no means of ascertaining whether this trade was being established or not. They ought to be given full statistics to show whether progress was being made with this trade or not, and on what particular lines they were making progress. The only way to make statistics really helpful to the whole trade was through the development of a spirit of willingness on the part of traders to give information voluntarily. It was amazing that firms would not give information which they knew would be for the benefit of the whole of the trade. It was very important that trade figures should have proper sub-division. In some statistics he had met with, woollens and worsteds were mixed together. He could not blame the Board of Trade for that. The only people to be blamed were the people who gave the information.

Before he resumed his seat he would like to appeal to everyone, not only to co-operate themselves, but to use their influence with others to get everyone engaged in the industry to give perfectly frank information and to work together, just as was done in America, so as to produce accurate statistics, which would prevent everyone in the trade doing foolish things and would show them whether they were gaining or were losing ground. He heartily thanked Mr. Shimmin for the trouble he had taken in preparing his paper.

Mr. G. H. Wood said that Mr. Shimmin had put much labour into this paper and had handled the figures admirably, but he wished that the labour had been spent on something more worthy of it than the material he had used. He (Mr. Wood) could not tie-in the record Mr. Shimmin was using with anything else in existence. He had wondered many times who were included in the number of insured persons on which the Department based its proportion and percentage of unemployment as given in the *Labour Gazette*, and Mr. Shimmin had given him some light. But the more he examined the figures the less value he put upon any one of them. That was not Mr. Shimmin's fault. In the first instance, look at the matter in the gross. It was only in 1921 that the Department attempted to tell how many insured persons there were in the woollen and worsted industries. They stated it as 274,870, but next time the figure

dwindled to 264,000. Then up it jumped again. He asked the Department what had brought about 5,000 persons into the woollen and worsted industry within a couple of months. He was told that, as he suspected, there had been no increase in the numbers employed; what had happened was that certain numbers had been transferred from a general to a particular group, but that they did not know how many. So that the continuity of the record was immediately destroyed. Mr. Shimmin spoke of 273,000 insured persons, but to-day the number had dropped to 257,700. He wanted to know how this came about.

In his opinion the first thing to be learnt from Mr. Shimmin's paper was the lesson which the Statistical Society had been teaching Government Departments for thirty years—that whether a record be good or bad its continuity should never be broken. Mr. Shimmin stated that this industry suffered from lack of certain forms of information. There was one record which was in existence from 1833 to 1904 and might, in his opinion, very well be revived. Under the Factory Act of 1833 the Factory Inspector was required to make inquiries and obtain returns of the owners of textile factories of the number of persons employed by them and of their classification according to certain ages and according to sex. This had not been done since 1904, but the power still rested in the hands of the Government, and could be used. From 1833 to 1904 the Home Office received information from each mill-owner of the number of looms, the number of combs, the number of carding machines, and of spindles, and he would venture to say that one of the most valuable steps that could be taken would be to issue that form again and make sure of getting it back. The Census of Production would not do. The divisions would not be the same. That was the only continuous record in existence which showed machinery and reflected the changes, and yet it had been dropped.

During the war he (Mr. Wood) had obtained periodical returns from wool-textile firms of the numbers employed and machinery used by them. These he had tabulated on similar lines to Mr. Shimmin's Table IX. Under the compulsory powers which he was using he could only find, in 1918, 60 wool-combers who had machinery. Mr. Shimmin recorded 78. He was perfectly sure there had not been such an increase. He was perfectly sure that the Employment Exchange records contained a number of "wool-combers" who had no machinery at all. His figures disagreed in other respects with Mr. Shimmin's figures. Not only were there wool-combers who had no combs, but there were evidently "manufacturers" who did no weaving. They might have an office with, perhaps, one or two persons employed, but they did their manufacturing through commission weavers. In his judgment such persons ought not to be counted as in the wool-textile industry when they were endeavouring to ascertain the average size of firms. A large number of such firms would not be included in the Home Office list of Textile Factories because they had no machinery. Therefore he suggested that Mr. Shimmin's analysis should be taken with this reservation.

Mr. EWING said that he wanted to offer a comment as a business man who endeavoured to use such statistics as were within his reach. If the Statistical Society needed any justification for dealing with the subject of the paper, it was to be found in the critical examination to which Mr. Wood had subjected Mr. Shimmin's paper. He agreed with Mr. Sutcliffe Smith in urging business men to supply information, and they should urge business men to make greater use of trade statistics. He had, however, no doubt that the Statistical Society got out a great many figures which were not generally understood, and unless these were spread among business men they could not apply those figures, nor could they learn from them how they could get more business, which was the main thing required. There was one deduction from Mr. Shimmin's paper which especially interested him—the number of small-scale businesses and the uneconomic effect of such business. If that paper led to these business men getting together for the diffusion of better and more enlightening statistics, then Mr. Shimmin would have achieved his object.

Prof. DOUGLAS KNOOP was called on by the Chairman, but he observed that he came from Sheffield, a place which had no practical contact with the subject. He had listened with very great interest to Mr. Shimmin's paper and also to the long contributions of those who had joined in the discussion.

(The vote of thanks was then put to the meeting and was carried unanimously.)

The PRESIDENT said that this had been a very successful and excellent discussion. There had been some criticism and a paper which gave scope for a good discussion. Statistics, it seemed to him, should always be looked at in the spirit of the Scotsman who remarked that he was open to conviction but "a dour deevil" to convince. That should always be their attitude towards criticism.

Mr. SHIMMIN, replying, said he appreciated the points put by Mr. Flux and was grateful for the exhaustive comment his paper had drawn from Mr. Hilton. Mr. Flux had pointed out that the Census and the Ministry of Labour classifications were originally drafted with different purposes in view, and comparability of the returns was not, therefore, to be expected. But the passage he (Mr. Shimmin) had quoted from the Census Reports seemed to foreshadow much closer co-ordination than had been achieved. His chief regret was that the most detailed return available (the Industry Tables of the Census) treated the whole of the West Riding as one area, and the distribution of woollen and worsted process workers in the chief centres in the Riding was not to be learned from that return. As the Ministry of Labour could not give the numbers employed in each process either in the Riding or at principal centres,

neither Census nor Ministry of Labour returns afforded that subdivision of the figures of employment which seemed desirable for the study of the shifting of employment from process to process or from town to town.

Mr. Flux had said that detailed figures for wool-sorters were given in the Occupations volume of the Census for each of the larger towns. That was true, but it was equally true that many of the remaining headings in the same group (Order XII—Textile Workers) included workers other than those in the woollen and worsted industry. This meant that no available return gave a clue to the actual distribution of workers employed in the different processes at the principal centres of the woollen and worsted industry. In asking for such detailed information from official returns, he realized that he might be asking for too much.

MR. FLUX : It is entirely a question of expenditure.

MR. SHIMMIN said he quite appreciated that difficulty, and knew that the Treasury had recently renewed its pressure on the expenditure. In reply to Mr. Wood's point about combers without combs, he (Mr. Shimmin) had expressly pointed out that some of the persons who called themselves combers were not entitled to that name. But the Ministry had to take people at their face-value when they made declarations of their businesses, and could not be expected to make investigations of the circumstances of each firm. In regard to the combers (or topmakers) without combs, and the manufacturers without looms, they were certainly engaged in getting work done. They were collecting orders in much the same way as the grocer's traveller, working on commission, would call for weekly household orders. These people collected the orders and got the work done and they were entitled to be counted in the industry. The present practice of the Ministry was to place these people in the classification in which they returned themselves.

Mr. Wood's point about dyers would be met, he thought, if he mentioned that dyers attached to "all-in" firms were included in the figures used in the paper. The figures did not include firms whose principal work was dyeing and who thus might cover textile goods other than woollen and worsted.

MISCELLANEA.

MR. RHODES' CURVE AND THE METHOD OF ADJUSTMENT.

By PROFESSOR F. Y. EDGEWORTH, F.B.A.

Introduction.—Mr. E. C. Rhodes, acting not for the first time as a pathbreaker,* has proposed a new method of representing frequency by analytic geometry. The new path diverges from the beaten road which he describes as the "Generalized Law of Error"; a title primarily applicable to the whole of a certain infinite series,† but by a convenient metonymy restricted to the available portion of that series. The retained portion may be thus written

$$(1) \quad y = \frac{M}{\sqrt{2\pi\sigma}} e^{-\frac{1}{2}\frac{x^2}{\sigma^2}} \left\{ 1 \mp \frac{\kappa}{2} \left(\frac{x}{\sigma} - \frac{1}{3} \frac{x^3}{\sigma^3} \right) \right\};$$

in accordance with the notation adopted by Professor Bowley in the fourth edition of his *Elements*, where σ is the standard deviation, and $\kappa = \mu_3/\sigma^{3/2}$, μ_3 being the mean cube of deviation from the arithmetic mean of the group. That mean point is taken as the origin. This construction labours under the defect that, unless the constant κ is very small, a sensible portion of the curve at one extremity, say left of the origin, lies below the abscissa. The curve then cannot, as a whole, faithfully represent a group of frequencies all of which are positive. To remedy this defect there has occurred to Mr. Rhodes the brilliant idea of constructing a new curve of the same family as the old one, but with constants so modified that the portion of the new curve's area which is above-board should be equal to the area of the given histogram, and that only the positive part of the curve should be taken into account in forming the expressions which are to be equated to the given (first three) *moments*. *A priori*, it appears evident that the representation of the lower extremity will be improved by this modification. On the other hand, there is an

* See especially *Biometrika*, December, 1924, p. 239 *et seq.*

† Cp. *Journ. Stat. Soc.*, vol. lxix, 1906, p. 497 *et seq.*

a priori presumption that the central portion of the group is best represented by the Generalized Law of Error.* Which of these considerations should preponderate will depend partly on the purpose on hand; largely on observation of the comparative success obtained by the two methods in the course of repeated trials. Mr. Rhodes' curve certainly appears to great advantage in the example which he has given. But the example is not a very typical case. It is on the borderland of the cases which have been described as "very abnormal."† Thus it does not fall within the Table presented by Mr. Frederick Brown in this *Journal* as an aid to the application of the Method Translation to cases of ordinary occurrence.‡ It is in this respect on a par with a curve specified by Dr. Greenwood§ in which the κ is much the same (viz. .6045), as Mr. Rhodes' (.6126). The coefficients of translation proper to that curve are approximately $\lambda = .2$, $\chi = .2$. But these are just the values which in a former article| have been noted as the extreme limits of ordinary groupings to which the widely appreciable method of translation applies. Accordingly it will not be denied that further trial of the new method is desirable. To those who undertake this work of verification the following remarks on the calculations involved may prove useful.

Determination of the constants.—The four constants pertaining to the new curve are determined from the same four data as the constants of the Generalized Law, namely, the given area and the first three moments. It might be wished that Mr. Rhodes had consistently used one set of letters, say Greek, for the original constants and different but corresponding letters, say English, for the sought constants; that as he has put σ for the original standard deviation and s for that of the constructed curve, he had analogously distinguished k from κ , and so on. His usage, however, is in keeping with the gem-like concinnity of the context, with his elegant approximation by stages, and with the fact that the whole space traversed by stages, the distance between the original and the constructed coefficients, is small. The last incident follows, in the view of the present writer, from the postulate that the case is not of the kind described as "very abnormal."¶ In virtue of this incident we might take for the sought coefficients the original ones each varied by a

* Cp. *Journ. Stat. Soc.*, *loc. cit.*, and vol. lxxvii, 1914-15.

† See *Journ. Stat. Soc.*, vol. lxxvi (1913-14), pp. 308, 745, *et passim*.

‡ *Ibid.*, vol. lxxxvii (1924), p. 582 and context.

§ *Biometrika*, vol. vii, p. 521.

|| *Journ. Stat. Soc.*, vol. lxxvii (1913-14), p. 308.

¶ See references given in notes to *Journ. Stat. Soc.* above.

small increment, *e.g.* for the new standard deviation $\sigma + \Delta\sigma$, where σ is the coefficient pertaining to the Generalized Law of Error, and $\Delta\sigma$ is an increment such that its second and higher powers may be neglected in comparison with the first for a first approximation. These increments will here be treated as the *quæsitæ*.

The *quæsitæ* thus defined may be connected with the data by means of the equations which Mr. Rhodes has given for the moments (including the zero moment, the area) of the constructed curve—the truncated moments, as they may be called, in forming which no account is taken of the negative ordinates. For instance, the first equation is (Rhodes, *loc. cit.*, p. 578)—

$$M_0 = M \left(1 + \frac{\kappa}{6} z (\lambda^2 - 1) - A \right).$$

Here M_0 is the coefficient pertaining to the original Generalized Curve which is equal to the (not truncated) area of that curve and is equated to the given area. M is the corresponding coefficient for the constructed curve, with this difference, that it is not equal to the not truncated area of that curve. κ is the coefficient which has already been introduced, or rather what that coefficient becomes as we pass from the original to the constructed curve. λ (interpreted with the same freedom as hovering between the original and the constructed curve) is the distance, measured in the standard deviation as unit, from the origin of the point at which the curve dips below the abscissa—the point Λ or L in our figure.* This coefficient is connected with κ by the equation

$$(2) \quad 1 + \frac{\kappa}{2} \left(\lambda - \frac{1}{3} \lambda^3 \right) = 0.$$

z is the ordinate for the normal error-curve with unit standard deviation at the point distant λ from the origin. That is,

$z = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\lambda^2}$. A is that portion of the area subtended by the

normal curve which lies beyond the point denoted by λ . I take the liberty of rewriting the equation as follows:—

$$M_0 = (M_0 + \Delta M_0) \left(x + \frac{\kappa + \Delta\kappa}{2} (\zeta + \Delta\zeta) \right) \left(\lambda + \Delta\lambda - \frac{1}{3} (\lambda + \Delta\lambda)^3 \right).$$

* Readers who are staggered by the jump from the integrals on p. 577, Rhodes, *loc. cit.*, involving powers of λ up to the fifth, to the equations on the following page which do not involve powers above the second, may be advised to reduce the higher power by substituting for λ^3 its value derived from the above equation, viz., $\lambda^3 = 3\lambda + \frac{6}{\kappa}$; and for λ^4 , $\lambda \times \lambda^3$, for λ^5 , $\lambda^2 \times \lambda^3$.

Here ΔM_0 is the small increment by which M differs from M_0 ; α is put for $1 - A$; λ is the distance of the dipping point from the origin for the original curve; and ζ the original ordinate at that point. Expanding and dividing by M_0 , we have approximated

$$\frac{\Delta M_0}{M_0} P + \Delta \kappa \frac{dP}{d\kappa} = 1 - P; \text{ where } P = \alpha + \frac{1}{6} \kappa \zeta (\lambda^2 - 1),$$

that is implicitly a function of κ , since α is a function of λ , and λ through equation (2), of κ . $\frac{dP}{d\kappa}$ is the *complete* differential coefficient of P with respect to κ , that is

$$\left\{ \left(\frac{dP}{d\alpha} \right) \frac{d\alpha}{d\lambda} + \left(\frac{dP}{d\zeta} \right) \frac{d\zeta}{d\lambda} + \left(\frac{dP}{d\lambda} \right) \right\} \frac{d\lambda}{d\kappa} + \left(\frac{dP}{d\kappa} \right),$$

the brackets denoting partial differentiation. Now $\frac{d\lambda}{d\kappa}$ is found from equation (2)* to be $\frac{2}{\kappa^2(1 - \lambda^2)}$. Thus, knowing the numerical value

of κ we obtain an equation of the first degree for the sought quantities $\Delta M_0/M_0$ and $\Delta \kappa$. In the case before us, $\lambda = 2.6$ (Rhodes, *loc. cit.*). Whence I find for a first equation

$$(3A) \quad \frac{\Delta M_0}{M_0} 1.0033 + \Delta \kappa \cdot 0.1306 = -0.0033.$$

The second equation is written by Mr. Rhodes

$$M_1 = -sM\tau \frac{\lambda}{2}.$$

Here, if we interpret M_1 as the truncated mean of the constructed curve, we may substitute for it ΔM_1 , corresponding to this coefficient's order of magnitude. Accordingly, in the case of this equation we may treat the quantities on the right side of the equation as the original quantities, their increments being negligible (in a first approximation). We have thus for a second equation—

$$\frac{\Delta M_1}{\sigma M_0} = -\zeta \frac{\lambda}{2}.$$

The left side of the equation denotes the distance of the new origin, the untruncated mean of the new curve, from the old origin, referred to the standard deviation as unit; a distance negative or positive, according as it is looked at from the new or the old origin, say τ ($= O\Omega$ in the Figure, if O denotes a point at about one-fiftieth

* Cp. note to p. 131.

of an inch to the right of Ω). In the case before us we have $\zeta = .0136$, $\kappa = .6126$, $\lambda = 2.6$. We may therefore put for the said distance in absolute quantity

$$(3B) \quad \tau = .011.$$

The third equation is obtained by equating the truncated second moment of the ancillary curve to the given mean square of deviation, σ^2 . Whence, expanding in ascending powers of the increments, and dividing by $M_0\sigma^2$, we have $\frac{\Delta M_0}{M_0}Q + 2\frac{\Delta\sigma}{\sigma}Q + \Delta\kappa\frac{dQ}{d\kappa} = 1 - Q$; where $Q = \alpha + \zeta\frac{\kappa}{3}(2\lambda^2 + 1)$, and $\frac{dQ}{d\kappa}$ is the *complete* differential coefficient of Q . Introducing the given numerical values, I find for the equation—

$$(3c) \quad \frac{\Delta M_0}{M_0} 1.0356 + 2\frac{\Delta\sigma}{\sigma} 1.0356 + \Delta\kappa .1236 = - .0356.$$

For the purpose of establishing this equation it makes no difference whether we take the (truncated) second moment about the original origin (Ω , the mean of the given histogram), as theoretically proper, or about the origin of the ancillary curve (O), since the respective moments differ by a quantity which is negligible in a first approximation, being proportionate to the *square* of the distance between the two points (τ^2).

But this convenience no longer exists when to form a fourth equation we utilize the *third* moment. There is now a difference between the two moments proportionate to the *first* power of the said distance ($O\Omega$).^{*} Expanding and dividing as before, we

obtain $\frac{\Delta M_0}{M_0}R + 3\frac{\Delta s}{s}s^2R + \Delta\kappa\frac{dR}{d\kappa} + 3\tau = \kappa - R$; where

$R = \kappa\alpha - \frac{7}{2}\kappa\lambda\zeta - 3\zeta$. As the numerical values of the coefficients

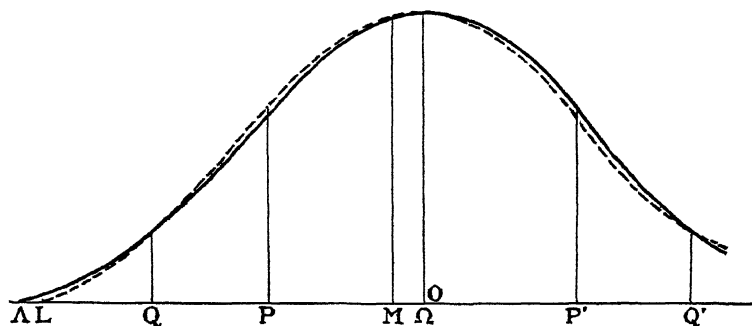
I obtain for R , $.493$; for (the complete differential) $\frac{dR}{d\kappa}$, $.6103$; for

$\kappa - R$, $.6126 - .493 = .1196$. We thus obtain a fourth numerical equation (3d). Substituting in this fourth equation the values, in terms of $\Delta\kappa$, of $\Delta M_0/M_0$ and $\Delta\sigma/\sigma$ obtained from (3A) and (3c) equations, and the value of τ obtained from (3B) equation, I find, for $\Delta\kappa$, $+.21$, which is in fair agreement with Mr. Rhodes' result, since he finds for the new κ , $.8$, and accordingly for $\Delta\kappa$, $.8 - .6126 = .1874$. The other increments found from our

^{*} Cp. Rhodes, *loc. cit.*, p. 379, par. 1.

equations are of the same order as those given by Mr. Rhodes. But I dare say that his corrections, the result of several stages of approximation, are the more accurate. We may have to proceed to a second approximation.

A methodical procedure such as that which has been set forth may be recommended as adapted to the construction of a table. The new method lends itself to tabulation, since corresponding to each observed value of κ there can be entered the value of $k (= \kappa + \Delta\kappa)$ calculable without regard to the values of σ and M_0 , as appears from the fact that P, Q, R are functions only of λ which is a function of κ . Thus the value of k found for one case, *e.g.* Mr. Rhodes' example, can be transferred to any case which has the same κ though differing in other features, *e.g.* Dr. Greenwood's curve above mentioned.*



An important type of frequency-curve.—This generic character is consistent with differences of species which may prove important for our purpose. One such division is intended to be indicated by the position of the point on the abscissa, which represents the *start* of the given curve, that point below which it is impossible, or at least very improbable, that the histogram should extend. The first alternative is illustrated by Professor Bowley's distribution of 10,000 words, according to the number of letters in them (*Elements of Statistics*, 4th ed., p. 304). As there cannot be a word without letters, the start of the histogram is at +1, or, rather, at +.5 if we imagine the (127) observations showing only one letter to be spread out between .5 and 1.5. The second kind of start is illustrated by Professor Bowley's distribution of the sums of letters in 10 words. As there are only 4 observations

* Above, p. 130.

below 26.5, presumably a point not much below that might be taken as the practical starting-point. The cases with which we have to deal may be divided according as the dipping-point (L) of the constructed curve is within or without the starting-point. Mr. Rhodes' example belongs to the former type. But there is reason to believe that the latter type, in which the start is above the dipping-point, is common. For the description applies to Binomials which are moderately asymmetrical, say $\kappa > .5$, and less than unity. Binomials are akin to the frequency-curves which are constituted by the composition of independent elements. That sort of composition is largely present in concrete distributions.

For evidence of the second and third propositions it must suffice to refer to former articles,* where there is maintained the hypothesis that the common shapes of frequency-histograms, and other statistical phenomena, are due to the composition of numerous independently varying elements. The Binomial may be regarded as a limiting case in which the element is perfectly U-shaped. The proposition which is to be proved for unsymmetrical Binomial elements may, with probability, be extended to neighbouring shapes such as in fact prevail.

To prove the proposition for groups formed out of Binomial elements, consider a tolerably asymmetrical histogram formed by n trials, the probability of success at any trial being p , a small fraction. The mean number of successes, np , which may be regarded as the abscissa of the zero point with respect to the mean as origin, cannot be so large as to exceed that multiple of the standard deviation which includes the significant portion of the ordinary generalized curve corresponding to our equation (1), say, 3σ . For let ρ be the ratio of np to 3σ ; that is, $3\sqrt{np(1-p)}$. Thus, $\rho = \sqrt{np}/3\sqrt{p(1-p)}$. Now \sqrt{n} is given in terms of p and κ ; since $\kappa = (1-2p)/\sqrt{np(1-p)}$. Substituting the value of \sqrt{n} derived from this equation in the expression for ρ , we have $\rho = \frac{1}{\kappa} \frac{1-2p}{3(1-p)}$.

This ratio increases continually up to the limit when p is zero and n is ∞ , that is, less than $\frac{2}{3}$ when κ is greater than .5. A like proposition holds if we take, as is often proper, for the limit or start of the histogram, not zero but $-.5$. There is now added to

* See the references given in the note on p. 572 of this *Journal*, vol. lxxxvii (1924).

ρ the small quantity $\frac{1}{3} \cdot 5\kappa/(1 - 2p)$; and ρ grows as p diminishes up to the limit $\frac{1}{3} \left(\frac{1}{\kappa} + \cdot 5\kappa \right)$; which would not become equal to 1 ($\kappa > \cdot 5$) until κ had the anomalously large value $3 + \sqrt{7}$.

For example, in the very unsymmetrical grouping formed by the number of letters in English words as tabulated by Professor Bowley (*Elements of Statistics*, p. 304), κ being $\cdot 78$, the distance of the mean $5\cdot 1453$ from the starting-point $0\cdot 5$ is $4\cdot 6453$ hardly more than $1\cdot 0$ times the standard deviation $2\cdot 86$. The point at which the curve dips below the abscissa is at a distance of about $2\cdot 5$ times the standard deviation.

What has been said about the ordinary Generalized Law of Error may be applied by way of lemma to the ancillary curve proposed by Mr. Rhodes. For by parity of reasoning it may be shown that, the histogram being a tolerably unsymmetrical Binomial, the dipping-point (L) of the constructed curve will be far outside the start of the curve, now situated to the right of L in our figure. Thus it may be shown that (κ being fairly large) the lower arm of the new curve (measured from the new origin) (O in the figure) up to the dipping-point (L) greatly exceeds the distance from the start (not shown in the figure), and greatly protrudes beyond the lower extremity of the histogram. We may now take the observed κ in the neighbourhood of its value ($\cdot 6126$) in Mr. Rhodes' example (e.g. $\cdot 609$, as in the following example), and presuming, therefore, that Mr. Rhodes' corrections are applicable to the case, for the new standard deviation s the old one $\sigma = 1\cdot 0268$ (*loc. cit.*, p. 579), and for the distance of the dipping-point from the new origin

$$2\cdot 4596 \times s = 2\cdot 395\sigma = 2\cdot 395 \sqrt{np(1-p)}.$$

For the distance of the starting-point from the new origin

$$np + \cdot 5 + O\Omega;$$

where for $O\Omega$ we may put, after Mr. Rhodes,*

$$\cdot 0189 \times s = \cdot 0184\sigma.$$

We have thus for r , the ratio of the histogram's left arm to that of the curve

$$\left\{ (np + \cdot 5 + \cdot 0184 \sqrt{np(1-p)}) \div 2\cdot 395 \sqrt{np(1-p)} \right\}$$

* *Loc. cit.* I assume that his " $\cdot 0189\cdot 5$ " is a misprint for " $\cdot 0189\cdot s$."

where $\sqrt{n} = \frac{1}{.609} \frac{1-2p}{\sqrt{p(1-p)}}^*$ Experimenting with the only available values of p ,† say from .07 downwards, you will find that v is ever a proper fraction ranging from about .8 to .9.

The new curve is liable to the grave defect of extravasation. But the old curve, the ordinary Generalized Law (our equation (1)) is liable in a greater degree to that defect (or rather excess). For instance, in the example given below, whereas of the new curve about 2 per cent. of the area is beyond the starting-point; the corresponding figure for the old curve is about 5 per cent.

A test case.—The disadvantage of the old method in this comparison may perhaps be compensated by its better fit at other points. To compare the two as wholes it is proper to apply the Pearsonian criterion of misfit to the respective results. For the purpose of this comparison I select on a fairly typical specimen of a Binomial that is asymmetrical in the degree of Mr. Rhodes' example; the distribution of successes obtained in the course of 46 trials, the probability of success at any one trial being .05. Here the standard deviation $\sigma = 1.478$, and the corresponding value of κ is .603. Treating this value as practically equivalent to Mr. Rhodes' .6126, and utilizing the ratios which he deduces therefrom, we have for s , the new standard deviation $1.478 \div 1.0268 = 1.44$, for κ , 8, and for the distance of the new origin (O) from the old one (O), $.0189s = .0272$. The new coefficient $M = M_j \div 1.0064$. For M_j the given area we take 2300, corresponding to Mr. Rhodes' 2295; supposing the results of 50 such experiments as have been described to be lumped together. The proportionate number of successes (0, 1, 2) that is to be expected out of any 46 trials is given in the row designated y_0 . The fit of a curve would be perfect if each portion of area between adjacent limits — ∞ — .5, .5 — 1.5, . . . 4.5 — 5.5, 5.5 — $+\infty$ were equal to the number of observations comprised within the tracts so delimited. The fit of the two rival curves is calculated in Tables I and II.‡ For the calculation I have employed as the formula for the area

* See preceding paragraph.

† In order that the Generalized Law of Error should be available, it is presumed that the expression for the ordinate should be expansible in descending powers of the modulus; which κ being given is larger the smaller p is, since $\sqrt{2np(1-p)} = \sqrt{2(1-2p)\kappa}$.

‡ The two tables would have been inserted here, but that at the last moment, when it was too late to recalculate them, a mistake was discovered in the arithmetic which renders it advisable to omit them from this issue of the *Journal*.

subtended by the abscissa x (less by the constant $\mp \frac{1}{3} j \frac{1}{\sqrt{\pi}}$),
 $\int_0^x y d\xi \mp \frac{1}{3} j \left(\frac{1}{\sqrt{\pi}} \times y (1 - 2\xi^2) \right)$; where $y = \frac{1}{\sqrt{\pi}} e^{-\xi^2}$, $\xi = \frac{x}{c}$,
 c is the modulus ($\sqrt{2}$ times standard deviation), $j = \frac{\kappa}{\sqrt{8}}$.

The negative or positive sign is to be employed according as ξ is measured to the right or the left of the origin. The values of y and its integral are taken from Burgess' Tables.

The respective sums Se^2/y_0 are to be multiplied by 2300 on the supposition that we are representing a group formed by fifty sets of 46 observations, distributed according to expectation. We have thus the criterion χ^2 for the Generalized Law 20·24, and for the Rhodesian curve 20·9. The difference appears insignificant, if account is taken of probable error, not only in the technical sense appropriate to a sample, but also in the literal sense of an error too probably incurred through neglect of decimal endings which were not quite negligible.

Moreover the criterion employed does not do full justice to Mr. Rhodes' curve. For it does not take account of the circumstance that the extent of protruded limb—or unsupported "tail"—is greater for the Generalized than for the Rhodesian Curve. In this connection it should be added that, even without comparing the tails, the sum of errors in absolute quantity according to Mr. Rhodes' method, viz., $\cdot 06 \times 2300$, is less than for the Generalized Law ($\cdot 08 \times 2300$). The success of Mr. Rhodes' method will appear more remarkable when it is remembered that it does not utilize any additional data beyond those which are required for the Generalized Law. Nothing has been added but an idea.

The Method of Adjustment retouched.—The success of Mr. Rhodes' method should not blind us to the claims of another method which purports to improve upon the Generalized Law without recourse to fourth moments: the Method of Adjustment described in a former article.* Mr. Rhodes has unintentionally dealt a serious blow against this method when he finds that applied to his example it gives a worse fit than the Generalized Law. It might seem at first sight that failure in a particular instance was not very serious. But this particular is of the kind which has been called with reference to diagrams used in geometry "representative particulars." If Euclid's rule for bisecting an angle was found to fail in a particular instance the reasoning on which the rule was founded would be discredited.

* *Journ. Stat. Soc.*, July, 1924.

Similarly the failure found by Mr. Rhodes seems to stultify the rationale of Adjustment, which consists in adding to the Generalized Law (or any other specified approximative formula) a function of appropriately cognate form with a constant that is to be determined so that the fit of the modified function may be as good as possible. The operation may be compared to the action of the fabled wren in the competition of the birds for the honour offered to the one who should soar to the greatest height. The wren, mounting on the back of the eagle, was carried as high as the soaring eagle could rise, and then executed herself an independent flight upwards. The wren would have been a poor bird if the altitude attained by her independent flight was less than that to which she had been carried by the eagle. A like unfavourable impression with respect to the Method of Adjustment is produced by Mr. Rhodes' announcement. His finding is no doubt to be explained by his having used a different instrument in measuring the height of the eagle and that of the wren. He applied the Pearsonian criterion to the results of the Generalized Law, but in determining the optimum of fit obtainable by Adjustment he seems to have followed too faithfully the present writer in employing the test which is formed by the sum of errors without regard to sign. I fear that I am responsible for some misconstruction through my not having expressed a preference for the use of the Pearsonian test in the operation of Adjustment. When that method was proposed in 1902,* it was excusable perhaps to have ignored the then recent Pearsonian criterion. But writing in 1924 I ought to have expressed a preference for that criterion, not merely to have mentioned it† (more than once) as a possible alternative. The omission is partly excused by the circumstance that the generally preferable criterion is in one respect, one relevant to our problem, not so available as the older test. That the latter is not entirely otiose will appear from the following comparison.

Criteria of good fit.—The Pearsonian criterion is related to the older test furnished by the sum of first powers (of errors without regard to sign) much of Laplace's Method of Least Squares‡ is related to his axiom that the sum or mean of errors constitutes the measure of disadvantage which is to be minimized. By a refined

* *Journ. Stat. Soc.*, vol. lxxv (1902), p. 327.

† *Ibid.*, vol. lxxxvii (1924), pp. 580 and 590.

‡ Interpreting Laplace's Method as in this *Journal*, vol. lxxi (1908), p. 510, and in the *Encyclopædia Britannica*, 11th ed., article *Probability* §§134, 135, where it is pointed out that Laplace does not postulate the normal distribution of the errors of observation, but, on the contrary, supposes "complete ignorance" of the law according to which the errors are distributed (cp. *Journ. Stat. Soc.*, vol. lxxxvi, pp. 589-90).

use of what is, perhaps, the most important theorem in Probabilities,* he first shows that, given a set of observations, the most probable value of the object to which they relate is their (weighted) Arithmetic Mean. But the method or instrument which is most probably right is not necessarily the best. Though it is more frequently right than any other, yet when it does go wrong its errors may be so serious as to outweigh the advantage of the said frequency. We require to be assured that the *disadvantage* attending its errors will be less than that incurred by any rival. Laplace obtains this assurance by assuming that the disadvantage of erroneousness is measured by the mean of the errors incurred in the long run (without regard to sign). There is no doubt something arbitrary in this assumption; and, as I have elsewhere pointed out, the conclusion (in favour of the Arithmetic Mean) equally follows from the less precise assumption that the detriment of error is *any* function of the error which continually increases with the increase of its variable.† Still, reference to advantage as distinguished from Probability is not otiose, even where the technique of Probabilities is most perfect, as Gauss, among other high authorities, has admitted.‡

Much more, in the practical decisions of common sense a rough estimate of detriment is serviceable. On the eve of the election to Parliament in the autumn of 1924, I accepted the position of umpire in a "sweepstake" which was thus constituted. A set of friends subscribed each a certain sum (say, a shilling) to a fund which was to be taken by the one who in the judgment of the umpire should have made the best prediction as to the distribution of the three parties, Liberal, Labour, and Conservative, in the new Parliament. I held that the goodness of any conjectured triplet was to be estimated by the smallness of its error, and that the magnitude of error was to be measured either by the mean first power of the divergences between the true and the predicted three numbers, according to the axiom of Laplace, or by the mean square of the divergences, according to the view of Gauss. Fortunately, the two tests concurred in designating the same individual.

Similarly, in the problem before us there will occur cases where the technique of Probabilities required for the Pearsonian criterion

* Professor Persons, in the *Review of Economic Statistics* (Cambridge, Mass.), July, 1925, has justly dwelt on the great importance and the common neglect of the proposition that the averages of numerous observations are distributed normally, however the observations themselves are distributed.

† *Philosophical Magazine*, 1883, vol. xvi, p. 383. Cp. Czuber, *Wahrscheinlichkeitsrechnung*, vol. i, p. 225 *et seq.*, ed. 1903; p. 266 *et seq.*, ed. 1908.

‡ Cited *Journ. Stat. Soc.*, vol. lxxi (1908), p. 386.

is not available; namely, when the misfit shown by a fictitious "tail" has to be estimated*. In this case, the most convenient estimate for the purpose of Adjustment appears to be the said Mean Error.†

The Method of Adjustment exemplified.—Either criterion, if applied consistently as the basis of Adjustment, must result in an improvement of the fit, except in the limiting case where the generally positive gain in accuracy becomes zero. Let us take as an example the statistics adduced by Mr. Rhodes. We need not begin at the beginning of the calculation. We will take for granted the errors committed by the Generalized Law as applied by him. They are shown in the fifth row of Table III, not inserted here. For instance, the calculated value for the point 4 or the compartment between 3.5 and 4.5 (viz., 451.8) exceeds the true value (440) by 11.8. Let us call that compartment the first above the Mean, and the compartment 4.5-5.5 the second, and so on; and likewise the compartment 1.5-2.5 the first below the Mean, and so on. We have to improve the fit by adding to the Generalized formula a function of the form

$$i(\frac{1}{2} - 2\xi^2 + \frac{3}{2}\xi^4) \frac{1}{c\sqrt{\pi}} e^{-\xi^2};$$

where, as above, ξ denotes number of successes, and c is the *modulus* of the relevant normal curve, i is the coefficient to be determined so as to minimize the misfit. Accordingly, we have to add to any the r th compartment the integral of the above expression between the limits of the compartment, that is

$$i\{(\frac{1}{2}\xi_{r+1} - \frac{1}{2}\xi_r + \frac{3}{2})y_{r+1} - (\frac{1}{2}\xi_r - \frac{1}{2}\xi_{r-1})y_r\}, \text{ say } \psi_r.$$

The error incurred by the compartment will now be $e_r + N\psi_r$, (where e_r is the error found by Mr. Rhodes, N is the total number of the observations, viz., 2,295.) We have then to determine i so that the Pearsonian $\chi^2 = \sum \frac{(e_r + N\psi_r)^2}{y_r}$ (where y_r is the true

content of the r th compartment) should be a minimum. Whence

$$i \sum \frac{N^2 \psi_r^2}{y_r} + \sum \frac{N e_r \psi_r}{y_r} = 0; \quad i = - \frac{\sum e_r \psi_r}{\sum \psi_r^2}.$$

The calculation is exhibited in Table III, resulting in a positive value of i , and showing that the improvement in this particular case is small, but still real.

To apply the other criterion it is proper to arrange in order of magnitude the values of i given by equating $e_r + N\psi_r$ to zero for each compartment, and opposite each such value to put its

* Cp. above, p. 138. † Cp. above, p. 140, and the paragraph next following.

importance as indicated by the (true) size of the compartment, y_r . The half-sum of the y 's indicates the position of the sought i . This subsidiary method which aims at minimizing the sum of errors without respect of sign also secures improvement as defined by that rule; by a somewhat different value of i , viz., a small negative fraction.

Uses of Adjustment.—The method of adjustment is not confined to the improvement of the second approximation (herein described as the Generalized Law) without recourse to fourth moments. It may also be employed to improve the first approximation (the normal law) without recourse to *third* moments. This procedure may be advantageous in cases where there is reason to think that the ordinary Generalized Law will prove very inaccurate at one extremity, the cases to which Mr. Rhodes is specially appropriate. We begin now by finding the errors E_1, E_2, \dots, E_r , incurred by the first approximation at each point or compartment. Then we introduce corrections of the type $jN\Phi_r$, where Φ_r is either the ordinate

$2 \frac{1}{c\sqrt{\pi}} e^{-\xi^2} (\xi_r - \frac{2}{3}\xi_r^3)$ or the corresponding integral between

ξ_r and ξ_{r+1} (ξ as before = x/c); *mutatis mutandis*, if instead of c and j we employ the coefficients σ and κ ($=\sqrt{8j}$). Then j is determined so that $\sum \frac{2(jN\Phi_r + E_r)^2}{y_r}$ (where y_r is the true number

of observations at each point, or within each cell) should be a minimum. The method is applied in Table IV to the Binomial adduced on a former page. The most advantageous value of j (or κ) proves to be much the same as that which is given by the ordinary method.

The result is in accordance with the subsidiary method according to which I find for j , .21.

The procedure may be extended to (moderately asymmetrical) frequency-surfaces. Let Z denote the normal surface which forms the first approximation expressed in terms of ξ and η each referred to the corresponding modulus as unit, and of the coefficient of correlation. For a second approximation there is to be added:—

$$-\frac{1}{6} \left(j_{30} \frac{d^3 Z}{d\xi^3} + 3j_{21} \frac{d^3 Z}{d\xi^2 d\eta} + 3j_{12} \frac{d^3 Z}{d\xi d\eta^2} + j_{03} \frac{d^3 Z}{d\eta^3} \right)^*.$$

* Cp., *Journ. Stat. Soc.*, vol. lxxxvii (1924), pp. 591-92. The reader may like a reference to a concrete instance of the constants here called j_{21} , j_{12} and j_{22} numerically ascertained, the second illustration in Pearson's stupendous study on the Fifteen Constant Bivariant Surface (*Biometrika*, vol. xvii, Dec., 1925, pp. 290, 292); where it appears that our j_{21} , j_{12} are by no means negligible in comparison with j_{30} and j_{03} .

Let E_r be the error incurred by the first approximation with respect to any ordinate (a given ordinate, or one taken to represent a small given column); and put Θ_r for what the last written expressions become when for ξ and η there are substituted ξ_r and η_r . We have then to determine the four j 's so as to minimize the expression for the Pearsonian χ^2 , viz., $\Sigma (\Theta_r + E_r)^2 \div Z_r$. Differentiating with respect to each of the four j 's we obtain four linear equations from which the best values of those constants can be ascertained.

More simply we might determine two of the constants, viz., j_{03} and j_{30} as usual from histograms relating respectively to ξ only and η only; and then by the process above described obtain two simultaneous equations for j_{21} and j_{12} . Simplicity has attractions for the practical statistician, who questions whether it is worth while to undertake elephantine calculations for the sake of the not very conspicuous advantages which are to be obtained by fitting curves and surfaces to the data of observation.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*Statistical Methods for Research Workers*. By R. A. Fisher, M.A. 232 pp. Edinburgh: Oliver and Boyd, 1925. Price 15s. net.

This book is No. 3 of the *Biological Monographs and Manuals*, edited by F. A. E. Crew and D. Ward Cutler and, as indicated by the Editors' preface, has a dual aim. It is intended, on the one hand, to provide an authoritative record of achievement in a particular branch of biological investigation and, on the other hand, to give the author an opportunity of presenting the results of his own researches in a more extended form. On the whole the second aim seems dominant, and we have presented a very full account of the statistical methods favoured by the author and of the conclusions he has reached on topics some of which are still in the controversial stage. Much is lacking if the book is to be regarded as an authoritative record of achievement in statistical method apart from Mr. Fisher's own contributions. The explanation may be found in the author's preface, where he says, "Little experience is sufficient to show that the traditional machinery of statistical processes is wholly unsuited to the needs of practical research. Not only does it take a cannon to shoot a sparrow, but it misses the sparrow." The task of reviewing the book is not made any easier by the fact that it is apparently addressed to the intelligent biologist, who is assumed to be able to

handle mathematical formulæ, but is spared the exercise of following a mathematical proof. We thus find in the earlier chapters excellent, if dogmatic, statements about binomial distributions, Poisson's series and the normal law, to which no exception can be taken by those who work the "traditional machinery." Side by side with these statements we find others equally dogmatic about maximum likelihood and similar topics without any warning to the non-mathematical reader that he is no longer on *terra firma*. In the sections in the earlier chapters dealing with distributions, goodness of fit, independence and so forth, the author explains clearly the use and meaning of the χ^2 test and provides simple tables for the purpose. Chapter V, on means and regression coefficients, is full of good matter, but the author, here as elsewhere, is very economical in his references to earlier work. A notable example is his description of the technique of fitting regression lines by least squares, so that each new approximation is a mere extension of the earlier stages. In this description there is no reference to Tchebysheff's work. A clear account of the usefulness of the product-moment correlation coefficients is given in Chapter VI. Mr. Fisher's sympathies are obviously with Mendelian methods, and the following quotation is therefore interesting: "but even with organisms suitable for experiment and measurement, it is only in the most favourable cases that the several factors causing fluctuating variability can be resolved, and their effects studied by Mendelian methods. Such fluctuating variability, with an approximately normal distribution, is characteristic of the majority of the useful qualities of domestic plants and animals; and although there is strong reason to think that inheritance in such cases is ultimately Mendelian, the biometrical method of study is at present alone capable of holding out hopes of immediate progress."

This chapter deals also with partial correlation coefficients and with the transformation devised by the author, $z = \frac{1}{2} \log \frac{b+r}{b-r}$, which simplifies the study of the distribution of r in small samples. Chapter VII is devoted to the study of intra-class correlations and their sampling errors, and a final chapter deals with the analysis of variance. Here the author uses the ideas underlying the correlation ratio but dismisses the ratio itself as a descriptive statistic the utility of which is extremely limited. The book will undoubtedly prove of great value to research workers whose statistical series necessarily consist of small samples, but will prove a hard nut to crack for biologists who attempt to use it as a first introduction to statistical method.

L. I.

2.—*The Fundamentals of Statistics*. By L. L. Thurstone, M.E., Ph.D. xvi + 237 pp. New York: The Macmillan Company, 1925. Price 8s. 6d. net.

The title of this book led us to believe that we were to read a discussion of the arguments for and against Bayes' theorem, the

method of least squares and such-like subjects, but we found that it was a text-book on elementary statistics for the educational psychologist, going through the usual methods of describing a frequency-group, its central tendency, its dispersion and its skewness, and finishing with the method of measuring linear correlation. As the book is primarily intended for the non-mathematical student, it deals with the methods of applying various processes of statistical analysis, rather than with their development, and, in fact, several pages are devoted to the outline of fool-proof rules for the guidance of the untutored novice when calculating some particular statistic.

There are various points which would be queried by the bright student. The author never makes clear his reason for assuming that, when calculating the mean of a frequency-group, the frequencies in the classes are concentrated at the middle points of the classes; in fact, he goes so far as to say that $\sum fx_m$ is the same as $\sum x$ where x represents an individual measurement, f is the frequency of the m th class, of which the measurement of the mid-point is x_m . This actually is not true in his illustrative example. He gets $\sum x = 12,990$ and $\sum fx_m = 13,110$ (pp. 68, 70). The author does not realize that when frequencies are represented by means of a histogram, frequency is represented by an area and not by a length. He does not make the measurement of correlation clear. He says that when the relation between two variables is perfect and positive the correlation coefficient is $+1$. It is difficult to know what is meant by "perfect and positive," except in the case of linear correlation. Of course, the author is thinking about linear relationships, but does not say so. After reading (p. 69): "The student of statistics should learn to dodge arithmetical work, especially mental arithmetic, wherever machines are available for the drudgery. This leaves one's mind free to formulate the problem, which the machines cannot do," the intelligent student will ask: "Suppose our brains are so busy *formulating the problem* that we put the wrong figures in the machine, or turn the handle too many times, what happens then?" Many statisticians, we believe, find that machine-grinding and arithmetical work afford a pleasant relief from the more arduous task on which Professor Thurstone would have us always concentrated.

On the whole this little book should prove useful to give notions to beginners in this field of the elementary ideas of statistics.

E. C. R.

3.—*Elements of Statistics*. By Frederick C. Kent. xi + 178 pp. London: McGraw-Hill Publishing Co., Ltd., 1924. Price 10s.

This little book has been written as a text-book for a first course in statistical methods. "It aims to meet the requirements of students who have not had college training in mathematics, and who will be unable to complete those courses in mathematics which are usually specified as pre-requisites to the courses in statistics." But if students are to be taught statistics without mathematics

on the lines indicated in the book, an essential pre-requisite is that the instructor should be a fair mathematical statistician, and further that he should have had a good deal of experience in accurate computing work under the supervision of someone who knows the mistakes which even Professors of Mathematics are liable to make.

The author realizes that it is essential in a book of this kind that there should be many illustrative examples at every stage. If anything, this book has too little reading matter compared with the examples; but, presumably, the explanations are mostly to be made in class. The illustrations throughout practically consist of various manipulations of thirty-five years' wholesale prices of coal and pig-iron obtained from the United States Statistical Abstract. These data are shown in the form of a frequency-table (with 19 classes), and in the form of a histogram and frequency-polygon. They are used to find means, modes and medians; measures of dispersion and skewness; correlation coefficient and correlation ratios. We were astonished to learn that a correlation coefficient of 0.77 indicated that, *on the average*, out of 100 cases of variations in prices, in 77 of these cases high prices of one commodity will be found associated with high prices of the other, and later that we deduce from the correlation ratios that there will be 90 per cent. and 78 per cent., respectively, of this kind of association. If the author counted the cases so associated amongst his data, he would have found 9 out of the 35. Lack of realization of the simple fact that frequencies represented graphically in the form of a histogram are shown as areas, leads him to confuse areas and ordinates of the normal probability-curve, and so he produces a pictorial representation of curve-fitting which is palpably wrong to the mere tyro, and theoretical frequencies which are, compared with the observed, removed by half a class interval.

Incidentally, the author also commits the unforgivable sin of using in his calculations two places of decimals at one time, and seven places at another time; but this may be due to the fact that he gives in an Appendix the Probability Integral Table from the "Book of Tables for Statisticians," without the differences. The author in the Preface asks for suggestions. We would recommend that he study the examples given in the Introduction to that "Book." Finally, the name of Gauss is associated with the correlation-ratio.

We do not suppose that this book will recommend itself to students and teachers in England. E. C. R.

4.—*Annals of Eugenics*. Edited by Karl Pearson, assisted by Ethel M. Elderton. Issued by the Francis Galton Laboratory for National Eugenics, University of London. Vol. I, Parts I, II, 256 pp. Cambridge University Press, Oct., 1925. Price 35s. net.

This new journal, the latest of the series of publications issued by Professor K. Pearson and his co-workers, is intended to provide

a home for 'otherwise homeless papers by trained scientists on problems of race in man. The format is quarto, 9½ in. by 12 in., the size of the page having been chosen to give ample space for pedigrees, etc. (making the volume rather awkward for handling), and it is intended to publish per annum one volume of some 400 pp.; the prepaid price to subscribers is 50s. net per volume. The first two parts run to 256 pp. (35s. net), and contain two long sections of papers on Russian and Polish Jewish children in East London, and on the relative value of factors influencing infant welfare, and two shorter articles. The first paper, by the editor, Professor Karl Pearson, and Miss Margaret Moul, is based on a physical, mental, and medical examination of the children at the Jews' Free School in Aldgate. Some 600 dossiers were obtained, relating to boys between ages 7 and 16, and nearly as many for girls; the inquiry was conducted in the main just before the war. As there are 144 tables alone, a detailed survey is impossible. The chief conclusions are as follows:—

"(1) While in stature the alien Jewish children are just about that of ordinary London schools, in weight they surpass at all ages the average, and compare even slightly favourably with the weight of children from the good district schools.

"(2) The girls exhibit far better nutrition, as determined by intercostal sulci, than the boys.

"(3) The results suggest that the Jews were less liable to tuberculosis.

"(4) The standard of the Jewish aliens in the matter of personal cleanliness is substantially below that of even the poor Gentile children.

"(5) There are double as many (Jewish) girls with their bodies really clean as boys; the sexual difference is overwhelming.

"(6) There is a far greater proportion of dull (Jewish) girls born in England than of girls of the same race born abroad.

"(7) The great fertility of these Jewish families is most noteworthy, *e.g.* the 618 boys were from families, often incomplete, varying from 5 of one per family to 1 of fifteen per family, the mode being 96 of six per family.

"(8) We can find in our data, with its considerable range of parental care and home environment, no appreciable effect of these home factors differentiating intelligence.

"(9) Speaking not of knowledge, but of mother wit, we are able to assert reasonable equality between Gentile boys and girls; this equality seems wholly wanting in the case of the alien Jew; Jewish girls have less intelligence than the Gentile girl in any type of (London County Council) school."

The paper, as far as published (the remaining section deals with, chiefly, the eyesight of the alien Jewish children), thus attacks many pre-conceived notions. Head (4) above in particular does not accord with the common view held by social workers and school

teachers who labour among Jewish children. It should also be pointed out that these children were descendants of Jews who came to East London in the decade before the war. The more capable parents probably soon left Whitechapel for better residential parts.

The second long paper is by Miss Ethel M. Elderton; the data used are found in reports of the Medical Officers of Health of Rochdale (for babies born in 1909 and 1910), Bradford (1911 and 1912), Blackburn (1908), Preston (1908), Salford (1908), Birmingham (1908), and of the City of Westminster Health Society (VI and VII reports for 1908 and 1909), based on material collected by health visitors in connection with baby welfare, including, in different cases, some of the following information:—

Health of baby at different times in the first year.

Health of mother at different times, and of father.

Place of baby in family.

Age of mother at birth of baby.

Nature of confinement (instrumental, difficult, etc.).

Condition of home (clean and comfortable, clean, fair, dirty).

Condition of food (good, fair—sufficient in quantity, but unsatisfactory in quality; bad—insufficient).

Habits of parents (good, indifferent, etc.).

Drinking habits of parents (teetotal, abstemious, said to be abstemious, drinks).

Occupation of father and employment of mother.

The areas and babies visited were usually specially selected, and not typical of the whole borough. The intercorrelations were apparently determined in as many cases as possible and some peculiar results obtained. The complication of the question and the crudeness of the available methods for dealing with the data is exhibited by the following examples:—

“(1) By including death in our health series of categories it will be found that the class dead have frequently a better environment than the class delicate.

“(2) We find practically no association between cleanliness and infant viability in a given year, when in that same year there is an association between cleanliness and the health of children of a year old.

“(3) In Bradford in 1911 there is practically no association between the habits of the mother and her employment, but in 1912 there is a small but significant correlation, much what might be expected from the relationship of cleanliness and the employment of the mother.

“(4) The race (Jewish) which has the lowest death-rate has the highest delicacy-rate.

“(5) In Blackburn and Preston, and in Bradford in 1911, it is the rather stronger women that are employed. In Bradford in

1912, and in Westminster in both years, the association is the other way round—the more delicate women are employed.

“(6) Table CIV gives the partial coefficients of correlation for habits of parents and infant vitality for constant employment of the mother, on Rochdale data, for 1909, $r = 0.084$, and for 1910, $r = 0.224$.”

The chief definite results that emerge are :—

“(1) A distinction between vigour and vitality: viability is not synonymous with the continuous factor we assume to lie behind the conception of health. . . . There seem to be two characters, independent but correlated, one of which might be termed viability and the other vigour.

“(2) Table XXV, Bradford, for correlation between habits of mother and father gives $r = 0.85 \pm 0.01$.

“(3) Table XXVII, Bradford, gives correlation between the health and the habits of the mother to be of order 0.5.

“(4) Deaths from (epidemic) diarrhoea are rather less discriminating than deaths from other causes, but diarrhoea certainly more often kills the delicate than the healthy baby.

“(5) There is a steady increase in the number of mothers with bad habits as the family increases in size (r is of order 0.25).

“(6) There is a correlation between first and abnormal confinements of 0.279 ± 0.042 , which is quite a significant association, and supports what has been the current opinion.”

We have only been able to pick out a few of the salient points from a lengthy paper of over 100 pages and 100 tables. Summing up this section, Miss Elderton says: “Where any association exists between the employment of the mother and infant viability, it is of a very slight degree . . . if the habits of the parents are made constant, the association between infant viability and the employment of the mother becomes insignificant.”

The last paper is by Mr. Anthony B. Hill, of the National Institute for Medical Research, in which he has attempted to deal statistically with the two opposing theories :—

“(1) Malthus observed that unless some such factors as improvement in agricultural cultivation, emigration, etc., exist, the birth-rate must be regulated by the death-rate.

“(2) The neo-Malthusians assert that modern populations are pressing against the limits of subsistence to such an extent, that if a high birth-rate is maintained it will produce a similarly high death-rate; if a low birth-rate is maintained, a low death-rate will be the result.”

The data used are the birth-rates and death-rates of England and Wales, and these rates and emigration figures for Sweden. All these are numbers changing secularly, and the correlations have been calculated by using the actual data, or data smoothed by

some method, and by assuming lags between the two rates of different times (*e.g.*, one year, two years, three years). The conclusions reached are that the smallness of the correlation found between the two rates suggests—in these two countries at these periods—that the other factors recognized by Malthus had an appreciable effect: in other words, that population pressure had very little existence, or was relieved by such factors as emigration, increase of food supply, etc.

F. S.

5.—*Studies in Human Biology*. By Raymond Pearl. 653 pp. Baltimore: Williams and Wilkins Co. 1924. Price \$8.

This book is a collection of Professor Pearl's writings over a period of more than twenty years. In his preface the author says that the only claim for unity in such a book is such as is inherent in the point of view of the author. That this point of view accepts the widest modern interpretation of the word biology as including the study of men as a community, and not only man as an individual, is evident from the range of subjects covered by the volume, which begins with a careful biometric study of brain weight, and ends with a section on population growth. One large branch of human biology, however—the mental and psychological—is barely touched.

The papers are collected under four headings:—Considering Man as an Animal, The Biological Aspects of Vital Statistics, Public Health and Epidemiology, and the Population Problem.

Of the six papers in the first section, that on the weight of the human brain is the most comprehensive, and gives a thorough and careful analysis of the available material. One minor point in it that the author has overlooked in his revision is a statistical misstatement on pp. 78 and 80. The multiple correlation coefficient cannot, of course, ever be less than the absolute value of any of the corresponding total coefficients. The apparent paradox discussed arises simply from an arithmetical slip.

Two short papers deal with the sex ratio, one from the point of view of racial crossing, the other dealing with the generally higher ratio among the Jews, but the author has not pursued this question very far.

The most interesting paper in the section on vital statistics is the short comparative study of the mortality of man and of the *Drosophila* fly, and of the rotifer *Proules decipiens*. The life span of other animals than man is an almost untrodden field.

Professor Pearl's "Vital Index" (births: deaths) shares the disadvantage common to all such indices—that the more they include the more they conceal. If a single index is to be used to measure "the biological essentials of a population," there is, perhaps, little to choose between the different forms that suggest themselves, but it is open to question whether the *difference* between the birth- and death-rate, rather than their ratio, does not give a more direct and simple measure of the natural increase of a population. The

idea behind the vital index calculated for specific age-groups is not altogether clear.

Taken as a whole, the author's papers on vital statistics show a stimulating fertility of mind which gives freshness to his treatment, though at times one feels that depth has been sacrificed to breadth.

The last section deals with a subject of which Professor Pearl has made a special study, and his rediscovery and wide applications of Verhulst's "logistic" curve for the growth of human populations are well known. As a descriptive tool and for interpolation purposes the curve promises to be of good service, but how much one looks on this as simply the result of the chosen equation being of the required flexibility, given a reasonable number of constants and the necessary dash of "e" usually called for in curves of growth, and how much one regards the asymptotic form as representing a real underlying biological law of any prediction value is a matter of individual temperament. The example of the curve for Japan stresses the need for caution in extrapolation. A closer association of these curves with the underlying social and industrial factors which shape their course would add much to their interest.

To discuss even superficially the many subjects treated in these essays would be beyond the limits of a review, and we must content ourselves with assuring even the most non-technical reader that, in spite of their statistical nature, he will not find them dull. Professor Pearl has a flowing pen and the tendency to follow new lines of thought.

The publisher's note giving the names of all members of their staff who have helped in the manufacture of this book is a custom which has much to be said for it as an encouragement to individual responsibility and pride in good work, and is here fully justified by the result.

E. M. N.

6.—*The Confessions of a Capitalist.* By Sir E. J. P. Benn, Bt. 287 pp. Hutchinson & Co., Ltd. Price 18s. net.

Confessions, as the late Lord Salisbury might have said, are always interesting, from St. Augustine to Rousseau, and from Rousseau to Sir Ernest Benn. But this book, though it makes capital reading, is less a confession than an *apologia*, in which the author states simply and forcibly the case for the capitalist manager in the business world. Politically Sir Ernest Benn is a convinced individualist, having no belief in the "State" action now so fashionable in each of our three parties, nor does he share the prejudice against profits which grew up during the war. On the contrary, he declares that his own profits have always made profits for everyone else with whom he was dealing, and he contends, justly enough, that profits are not an addition to prices, but an incentive to greater production and lower prices; high profits, indeed, are their own cure. Sir Ernest Benn has been a business man since the age of sixteen; as his parents married young, and had a large family, he escaped the handicap of a university education. He has the highest

opinion of business as a career, since "doing business is doing real things," and he advises every young man to try twelve months as a commercial traveller in order to understand the point of view of producers and consumers.

Perhaps the word "Confessions" was suggested by our author's admission that he has an income of £10,000 a year, but he contends that he earns it all in rendering services to other people; and he thinks that, on a turnover of £400,000, his commission of $2\frac{1}{2}$ per cent. is a modest one. Starting from a turnover of £5,000, it has taken him thirty years to reach this figure; meanwhile, the rate of profit has declined from 20 per cent. to less than 5 per cent. Several interesting tables give, in detail, the trading accounts of successful and unsuccessful trade papers, from which it appears that a successful journal may get from 90 to 95 per cent. of its revenue from advertisements, and only the meagre balance from sales; while printing and paper absorb more than three-quarters of its expenditure. Contributors only get from $2\frac{1}{2}$ to 4 per cent., and from the accounts of one unsuccessful paper we observe that the block-makers, who are distinct from the printers, took almost twice as much out of the enterprise as the men and women who wrote for it. It is part of Sir Ernest Benn's theory that attempts to equalize incomes by Government action are actively mischievous; he gives a whole chapter to Pareto's Law, which says, in effect, that society is, and must be, built up on the pyramidal principle, so that when, as in Russia to-day, you destroy the wealthy class at the apex you impoverish the rest of the population all the way down. A table based on the numbers of incomes of six different sizes which were listed by the Inland Revenue authorities seems to support the Italian economist's theory. This table we reproduce in the author's form:—

Increase in Numbers at certain Incomes.

£160—£300.	£300—£700.	£800—£1,000.	£1,000—£2,000	£10,000	Over £50,000.
<i>No. in 1895.</i>					
222,693	5,591	6,672	11,069	1,314	56
<i>No. in 1920.</i>					
3,194,100	74,850	86,560	142,870	16,720	660
<i>No of times increased.</i>					
14	13.5	13	13	13.5	12

In one way this table works against another of the author's theories, because it indicates that all the semi-socialist legislation of the last twenty years has not prevented a steady increase in the larger

incomes. A chapter called "Five Weeks in America" gives a further opportunity of criticizing English social legislation, since we are shown a prosperous community, with a standard of living higher than anything known before, "who know nothing of old-age pensions, of health insurance, or of unemployment pay."

While most people think our English tax system the best in the world, Sir Ernest has some sharp criticism of it. First of all, he complains that a good deal more than half his income is taken in taxes and rates; secondly, he takes the stronger objection that the vast majority of electors feel no personal responsibility for the policy which their votes have authorized, or endorsed; indeed, as the table quoted above suggests, income-tax payers form an insignificant fraction of the electorate. A further point is that income tax has now become so high that the taxpayer takes his income tax into account as a kind of business expense and passes it on to the consumer as an addition to his charge for goods and services.

J. E. A.

7.—*Labour and Housing in Bombay: A Study in the Economic Conditions of the Wage-earning Classes in Bombay.* By A. R. Burnett-Hurst, M.Sc. (Econ.), F.S.S., I.E.S., Professor of Commerce in the University of Allahabad. With a foreword by Sir Stanley Reed, Kt., K.B.E., LL.D. xiv + 152 pp. London: P. S. King, 1925. Price 10s. 6d.

"The condition of the labour force in the industrial centres of India," observes the late editor of the *Times of India*, in his foreword, "is one which sadly perplexes the industrialist, the humanitarian and the sociologist." Labour is insufficient, and dear in relation to output. Living conditions are deplorable. Just lately there have been signs of improvement, but a more active policy is needed in the destruction of dwellings unfit for habitation. Higher wages are often lost in increased absenteeism, and the worker is the prey of a large parasite class. "The immediate problem of Indian industry," concludes Sir Stanley Reed, "is not so much the raising of wages . . . as the extraction of higher service for the wages paid and securing the workman a better return for the wages which he is supposed to receive."

Mr. Burnett-Hurst's study is a thesis approved for the Degree of Master of Science (Economics) in the University of London. It is interesting to compare the present investigation with that of *Livelihood and Poverty* (1915), in which he and Dr. Bowley investigated working-class conditions in four representative English industrial centres. Their samples comprised some 2,100 residences, representing about one-twentieth of the whole. Broad results were checked from independent sources, and owing to the rigorous methods of sampling employed the details can be regarded as typical. The margin of error was small, probably less than 5 per cent.

The Bombay programme contemplated the visitation of 466 residences in a typical area under similar rigorous conditions.

Owing to industrial unrest the enquiry had to be abandoned at an early stage, and only 121 cases became available for tabulation. In view of the small size of the sample, the precision of the Bombay figures cannot possibly be greater than one-fourth of the precision of the English figure, and when account is taken of heterogeneity of material and of the illiteracy of the population, the standard of accuracy must really be much lower. Results are compared with the results of an enquiry into working-class budgets by the Bombay Labour Office. As the Labour Office samples were not random samples there are considerable divergencies between the two sets of figures.

The real value and substance of the book lies in the record of the author's personal enquiries and observations, which have been of the most exhaustive description. Mr. Burnett-Hurst has gone down into the Bombay slums; in plain, measured, dispassionate language he tells exactly what he has seen for himself, and illumines his description with the comments of a man thoroughly versed in labour matters, both in India and at home. Personal research is liberally supported by independent statistics and quotations from official papers. The tale is one of unredeemed poverty, filth, misery, and desolation. The habits and customs of the people and the inertia of the employers, the authorities, and the general public appear from his account to be equally to blame.

"According to the Census of 1921, there were in Bombay no less than 135 instances in which a single room was occupied by six families or more." Bombay possesses the inglorious distinction of having probably the highest infant death-rate in the world (667 per 1,000 in 1921). Nearly 60 per cent. of the inhabitants live in areas with a density of 250 persons per acre. The majority of the wage-earning classes are housed in "chawls"—buildings let in separate tenements. The standard of accommodation is scandalously low, and sanitary conditions are incredibly filthy. In 1917-18, about 97 per cent. of working-class households were living in single rooms.

Bombay's chief industry is cotton-spinning and weaving. Hours are long and wages are low. Employment of children is encouraged. There is a factory code, but evasion of its provisions appears to be fairly easy. Low earnings have to be considered in relation to living conditions. The needs of the workman are very small, judged by European standards, and vary considerably according to his caste. It has not been practicable to draw a "poverty line," as in *Livelihood and Poverty*.

The results of enquiries among the dock labourers, in the building trades, in the dockyards and in the railway workshops, are included, and there are interesting chapters on Trade Unions and Welfare work. In both matters development has been slow, and in trade-union matters it has lately been retrogressive. Comparatively little encouragement has been given to either movement by the employers, and although works committees have been established by the more

enlightened, the scope and functions of these committees have been severely restricted.

A number of statistics relating to working-class households are collected in an appendix. This appendix includes eight family budgets, for what they are worth. Other appendices give statistics of dock labour and of industrial disputes. There are also a two-page bibliography and a welcome glossary of Indian words, besides a map of Bombay, and many excellent and characteristic photographs taken by the author. There is no index.

Mr. Burnett-Hurst is to be congratulated upon an admirable piece of pioneer work, and it is to be hoped that his efforts will stimulate similar enquiries in India and elsewhere upon a larger scale.

L. R. C.

8.—*American Petroleum: Supply and Demand.* A Report to the Board of Directors of the American Petroleum Institute by a Committee of eleven members of the Board. xiii + 269 pp. New York: McGraw-Hill Book Co., Ltd., 1925. Price \$3.

This work is divided into three parts: Part I, containing the letter of transmittal and a summary of the Report; Part II, relating to the supply of petroleum from all sources in the United States of America, viz., oil-wells, oil-shales, coal and lignite, and also referring to methods of recovery and practice; and Part III, in which is considered the future demand for oil in the United States. Finally, several valuable appendices and an excellent index are included. The volume contains ten tables, exclusive of those in the appendices, as well as ten diagrams of the nature of "curves." The Report is the outcome of the action of the President of the United States—at least, it results from his action—in creating a Federal Oil Conservation Board to consider the nation's future supply of petroleum; and the general conclusion arrived at by the Committee is that there is no imminent danger of the exhaustion of the petroleum supplies of the country—a somewhat sanguine conclusion in view of the facts stated further on in the Report.

They state that there are 5,300 million barrels (a barrel contains 42 U.S. gallons) of crude oil recoverable by existing methods of pumping and flowing from existing wells in the proved areas, and that after pumping and flowing there will remain 26,000 million barrels, "a considerable portion of which can be recovered by improved and known processes, such as flooding with water, introduction of air- and gas-pressure, and mining when price justifies." They hazard the opinion also that deeper drilling will discover more oil; but this is in the nature of surmise and a conclusion open to doubt, for the tendency of oil is to move upwards especially under earth movements resulting in pressure, heat and fissuring, for which reason great quantities of the world's original supplies of oil have vanished in the absence of an impervious capping.

The latest survey of the United States oil reserves was made in

1921 by the United States Geological Survey, in co-operation with the American Association of Petroleum Geologists. The estimate then arrived at gave the entire United States a reserve of 9,150 million barrels. The Report states that the present (year 1924) fuel-oil demand is 391 million barrels per annum, so that at that rate of consumption the known reserves of oil will last for twenty-two years. But the demand is increasing and, it is estimated, in 1930 will reach 455 million barrels, in 1940 573 million barrels, though estimates of this sort are apt to prove wrong.

Deeper oil-bearing sands *may* be found, new fields *may* be discovered—it is estimated that there are 1,105,454,459 acres in which new oil-fields may be discovered—but if not, the situation to the ordinary man would appear serious enough.

With regard to the possibilities of the recovery of the oil remaining in the sands when pumping ceases to be effective, one gathers from the Report that little or nothing has yet been attempted in the United States by way of flooding with water or restoration of the pressure, artificially, which originally caused the oil to flow, nor by way of mining. In these respects Europe appears to lead the way. One learns that in the Pechelbroon region, in Alsace, mining of oil sand for the recovery of petroleum has been carried on successfully for a number of years. It is reported that, after the field had been exhausted by pumping and flowing, they mined the sand, and that all but 8 per cent. of the original oil-content in the sand is recovered. But when it comes to obtaining oil by mining and, probably, retorting of the sands, it will probably prove more profitable to obtain oil from coal.

With regard to the conservation of resources of oil, the Committee lean to the views that the most hopeful fields lie in the direction of the production of more "gasoline" (petrol) by "cracking," and the improvement in automobile design with the object of obtaining a greater mileage for a given quantity of spirit. They quote a statement by the President of the General Motors Research Association, who said: "We believe that it is possible to make automobiles go twice as far per gallon of gasoline used. The present internal-combustion engine and automobile only transform an average of 5 per cent. of the energy originally in the gasoline into useful work. It is possible at present to transform 10 per cent. of this energy into useful work, and this would be common practice in the future." Mr. H. L. Horning, President of the Society of Automobile Engineers, stated in December, 1923: "When the public want it they can go 40 miles per gallon on small cars."

How serious to America is the question of the future supply of what we term petrol is realized when one considers the extent to which the United States populace are using automobiles. The population of the United States in 1920 was 106,418,000 persons, comprised in 26,604,000 families, and there were (inclusive of motor-cycles and aeroplanes, etc.) no less than 13,028,000 automobiles—or one for every two families!—and the number is on the up-grade.

The oil industry of the United States dates from 1859, since when each decade has witnessed a volume of production equal to that of the whole previous history of the industry. During the nine-year period 1916-25, more oil was produced in the United States than during the whole previous period 1859-1916. The Committee put the importance of the industry to their country in a nut-shell when they say (p. 27): "From the soil of the United States is taken year by year seven-tenths of the billions of barrels of oil produced throughout the world," and "America's petroleum products, in some form or other, provide one of the largest classes of export to foreign markets."

As pointing to the highly speculative nature of the industry, it is interesting to learn that of the 658,059 wells that have been drilled in the United States, 133,453 were failures and 228,447 were either gas wells or have been abandoned. So there remain 296,147 producing-wells at the present time.

That portion of the work relating to oil-shales, coals, and lignites may be read with interest though it adds little to our previous knowledge. With regard to the oil-shales, it should be pointed out that the failure hitherto to discover a process for securing the desulphurization of the oils recoverable therefrom rules out many of these as possible sources of supply—a fact which is not alluded to in the Report under consideration. The remarks on low-temperature carbonization (pp. 157, 165) are in need of some modification, in view of the latest developments in this process in Westphalia.

The work will doubtless be studied with advantage by experts in petroleum, and it is so untechnical in its phraseology that it can be recommended for perusal by the general reader also. It must for some time remain the chief source for the supply of data relative to the petroleum industry of the United States of America.

R. A. S. R.

9.—*The Present Position and Prospects in the Wool Textile Industry.* By Arnold N. Shimmin. November, 1925. Special Memorandum No. 15, London and Cambridge Economic Service—London School of Economics. *Statistical Review of the Wool and Wool Textile Trades, 1912-14.* London: H. Dawson & Co., 74, Coleman Street. E.C.2. Price 10s. 6d.

Mr. Shimmin's Memorandum is a valuable contribution to the understanding of the situation in the wool-using industries. A few criticisms may be quickly disposed of. He truly says that no census of present productive capacity in terms of machinery is available, but since he wrote some particulars have been furnished by the worsted industry in connection with their "safeguarding of industries" application; the desired information will be available if all firms receiving the Census of Production Schedules for the woollen and worsted industries furnish thereon the details of machinery which they are asked to supply. These same Returns will enable a measure of the home trade to be ascertained.

An analysis of the Occupations and Industry volumes issued in connection with the Population Census of 1921 will give the information as to numbers employed at that date in the different sections of the industry, the lack of which is lamented in the Memorandum. On p. 7 Mr. Shimmin refers with apparent approbation to the estimates of wool production made by Sir Arthur Goldfinch and others, but he omits to observe that the great slump in wool prices in 1925 has disproved the estimates of "shortage" based on these estimates and has aroused in the trade a widespread distrust of the figures, so much so that the International Institute of Agriculture at Rome is now considering the collection of more reliable statistics regarding the wool industry. Reference might also have been made to the larger Australian clip of the current season. A brief section of the Memorandum is devoted to "conversion costs," and prominence is given to the assertion that the charges for combing, dyeing, finishing, and other services, made by various combinations, are too high, but no evidence on the matter is furnished. On November 23 combing charges were reduced about 10 per cent. Meanwhile, it may be noted that the Court of Enquiry, in deciding that basic time-rates in the industry proper should remain unaltered till the end of 1926, appeared to regard the remuneration of the workers as not bearing an undue proportion to total costs.

After all this has been said it remains that Mr. Shimmin has provided a very useful summary of the leading facts in the post-war history of the wool trades, and has supported it by an instructive selection of statistics. This is not the place to examine his presentation of the economic situation, but occasion may be taken to emphasize the need for more accurate, more frequent, and more abundant statistics relating to wool, not only in producing countries but in consuming countries, including our own. The reported reduction of the Australian clip this season from the earlier figure of 2,300,000 bales to 2,000,000 bales ought to be impossible, and on the consuming side there is an urgent necessity for knowledge of the stocks of wool in all hands in each important manufacturing country; to secure this information for the United Kingdom would require legislation.

Messrs. Dawson's *Review* is well known. It contains a summary and reproduction of the principal wool statistics of the United Kingdom, France, Germany, United States, Australia, New Zealand, South Africa, and South America, embracing (so far as they are available) particulars of the number of sheep, wool production, imports and exports of wool and products, prices, and employment. Generally, the figures cover the period 1913-24, but in some instances relate to longer, in others to shorter, periods. The final section includes a table and graphs of wool textile trade index-numbers reprinted from the *Journal of the Bradford Chamber of Commerce*.

H. W. M.

10.—*The Economic Development of the British Overseas Empire.* By Professor L. C. A. Knowles. xv + 555 pp. London: George Routledge & Sons, 1924. Price 10s. 6d. net.

To write for the first time an economic history of the British Empire was an immense task. The mass of material (only too much of it in the unattractive form of blue-books) is prodigious; and to discern the analogies in the development of the different areas, to analyse the motives underlying that vast and largely unconscious expansion, and to show the same ultimate causes at work throughout required a real historical imagination. That Professor Knowles should have been wholly successful was perhaps hardly to be expected. She has occasionally been overwhelmed by the volume of the evidence which she has collected (and which in every case she scrupulously refers to its source): the leading ideas tend sometimes to be lost in the multitude of facts. Moreover, she has not the gift of the illuminating phrase: her style is a little dull, and when she tries to be figurative the effect is not happy. Such statements as that in Australia "the penetration hinged on the walking capacity of animals" (p. 13), or that in Kenya "the usual trinity—tsetse, human carriers, slaves—was the result" (p. 498) are distressing. Nevertheless, as a whole the book deserves little but praise.

The general plan is sound. The first hundred pages sketch the economic history of the Empire, the various types of colonization, and the methods successively applied, in broad outline. Fifty pages are then devoted to the special problems of the Tropics; and the remainder of the volume considers in detail the Indian Empire (200 pp.) and the smaller Eastern and African Colonies (50 pp.). A second volume will deal with the Dominions.

There is, perhaps inevitably, a certain amount of repetition. For example, the peculiar economic consequences of the abolition of slavery in Africa, which destroyed over wide areas both the chief means of transport and the chief marketable commodity, are explained in the general introduction, in the introduction to the tropical section, and in the sections devoted to individual colonies. The broad solution of the problem was the employment of the freed slaves on the construction of the transport facilities which took their place.

One thing the book is certainly not: it is never uninteresting. Except for an occasional purple patch selected from the writings of this or that ex-Governor, Professor Knowles is content to let the facts speak for themselves; and it is enough. The tale, however told, could not help being romantic. The relations with the natives, the problems of population, the agricultural experiments, the kaleidoscopic changes of trade, the vast engineering works, the technical achievements such as cold storage, the war against the tsetse fly and the *Anopheles* mosquito—these and a hundred minor details make up an absorbing story: a story, too, without an end, since one is always led up to a point at which one can only wonder what immense new developments the next generation will see.

Already Professor Knowles's account of transport in the Tropics needs amplifying by a mention of the forthcoming trial of roadless tractors, which not only make their own track but leave a passable road for cars (see *Board of Trade Journal*, November 5, 1925). As an example of the changes of trade we may quote the case of Ceylon, where coffee succeeded cinnamon, but after thirty years succumbed to disease and gave place to quinine, which in its turn was replaced by tea and later cocoa; while "the largest area of land in the island is now devoted to coco-nut growing" (p. 124).

Economic history is in some ways the most difficult sort of history to write. It cannot be a mere record of interesting events: *ex hypothesi* the whole development proceeds by known laws from conditions which can be identified, classified, even measured. It is only where politics intervene (as in the question whether native organizations should be preserved, destroyed, or remodelled) that one can be content to ascribe events to human caprice; otherwise one must somehow lay bare the essential logic of the evolution. Taking all the difficulties into account—the scattered and indigested material, the variety of the local conditions, the changes in policy (when there was any policy at all), the haphazard way in which so many of the Colonies seem to have grown up—to have produced an account at once so connected and so comprehensive is a notable piece of work. There are some obvious gaps—currency problems certainly need more discussion than the bare summary on pp. 248–50, and the general remarks on the attitudes of different nations to their colonial subjects (pp. 152 foll.) might well be expanded—but if in subsequent editions the new material is successfully incorporated, and at the same time the broad lines of development are made to stand out rather more sharply, the book should become of the greatest value not only as a record of its subject, but also as a store-house of examples for the theoretical economist.

Professor Knowles is to be congratulated not only on having broken new ground, but on having worked it with skill and industry.

H. F. C.

11.—*The Economic Laws of Art Production.* By Sir Hubert Llewellyn Smith, G.C.B. 246 pp. Oxford University Press, 1924. Price 6s. net.

The casual observer may think we have here another *Political Economy of Art*. But that work, amid a wealth of references, is nowhere alluded to, and the scope and method are altogether different. One of the subjects recently included (at the suggestion of the British Institute of Industrial Art) in the scheme of study for the Bachelor of Commerce Degree in London University is "Art in Relation to Commerce." No lectures or lecturers appeared on the ground to lead the "young idea." What more natural than that the Chairman of that Institute should, Moses' mother-like, essay the task? From those lectures this book results. Its aim

is to apply the methods of economic science to the discovery and exploration of the special laws and tendencies which affect the production and distribution of such material objects as fall within the category of works of art. The author is very modest in his initial and final claims. His work is "preliminary" and "provisional," and he reaches "suggestions for further thought," rather than definite conclusions—"a term too confident, not to say arrogant, to describe the more or less vague ideas which emerge from our brief and imperfect survey."

The ultimate nature of Art and Beauty is never sought; sufficient that a human desire is ministered to, for which economic sacrifice is made; sufficient that in production certain basic economic costs are essential. An important differential feature of art products is found in their essential unity, and, therefore, the far-reaching economic influence of division of labour finds but limited scope here. But inasmuch as so large a part of art exists in design for material objects, modern machine industry restricts the range of designers' control, though, indeed, it segregates designing into a separate and special function. The rival lines of independent studios and workshop-designs appear at this point. There is an interesting chapter on economic fitness as a condition of art value which attempts to assess standards of "fitness." A work of art is a function of many variables of which fitness for its purpose is one, and here is covered not merely technical fitness, but also harmony of purpose and cost and an "economy" of material. This gives a tentative suggestion of a law: "Other conditions being equal, the art value of a product is maximized if the result is obtained at the minimum of economic cost." What influence has international exchange upon art values? Does it diminish them, or does isolation conserve them? Political frontiers tend to become inter-cultural frontiers, and the new movements which come from blends are a quasi-biological phenomenon. The problem of supply as a response to short-period demand, or fashion, and as contrasted with long-period trends and steady classic types, raises many fascinating issues. The economic as typifying the material, and art as representing its antithesis, would seem, at first sight, to have no substantial nexus or extensive common ground, but this book indicates how dependent both development and standards are upon economic considerations, even for those who have a soul above such things. At the same time the characteristics of art are so distinct that economic laws often find in them a limiting case from which some new conception of the laws themselves may be obtained. If the highest forms of art are to be "encouraged" in an economic sense, steady demand must be created. This demand must be created either directly or indirectly; in other words, either by raising the general level of artistic appreciation and judgment, or by the less worthy, but probably more feasible, method of playing upon the sense of vanity and distinction to this end. Many a man who can never be educated to desire instinctively the better thing may be led to desire it

if he thinks it will mark him out for distinction and culture, because recognized judges have labelled it as good.

The work is by no means arrestingly written for a rapid perusal, but it grows in a kind of sterling and worthy quality as it is mastered. The author's claims for it are so restrained that one can say cordially they are more than justified.

J. C. S.

12.—Other New Publications.*

Constantinesco (Milita). L'Evolution de la Propriété rurale et la Réforme agraire en Roumanie. 479 pp. Bucarest: Cultura Nationala, 1925.

[An economic and historical account of the agrarian reform movement in Roumania, from feudal times down to the post-war periods of expropriation under the agrarian laws of 1917 and 1921. The author is at pains to show that this movement in Roumania has been based on the gradual economic development of the country, and is foreign to the somewhat similar changes which have taken place in neighbouring countries under revolutionary influences. There is a bibliography and a full table of contents, but no index.]

Cutforth (A. E.), F.C.A. Foreign Exchange: Treatment of Fluctuating Currencies in the Accounts of English Companies. vii + 168 pp. London: Gee and Co., 1925. Price 11s.

[Mr. Cutforth's book is considerably more than an enlarged edition of his work on this subject, issued in 1910, and, in view of the present fluctuating state of the currencies in many countries, it will be welcomed by all occupied in transactions abroad. Besides dealing with difficulties of auditing which are incidental to foreign exchange, the book contains many examples of the treatment of accounts in various kinds of concerns, and these serve to illustrate the principles discussed by the author. There is a chart showing the course of the currencies of eleven countries as compared with sterling in 1914-24.]

Dorizas (M.). The Foreign Trade of Greece. The economic and political factors controlling. 138 pp. University of Pennsylvania, 1925.

[Mr. Dorizas' thesis is a painstaking survey of the geographic, social and economic conditions of Greece, and of their varied influences on the development of the country. Natural resources, agricultural production, manufacturing industries, and conditions of transport are briefly described; the commercial policy of Greece and future trade prospects are also dealt with. There is an appendix of statistical tables and a bibliography.]

Dupont-Ferrier (Pierre). Le Marché Financier de Paris sous le Second Empire. x + 245 pp. Paris: F. Alcan, 1925. Price 10 frs.

[An economic and statistical study of the French money market from 1852 to 1870, a period of great financial and industrial activity and

* See also "Additions to the Library," p. 194 *et seq.*

development in France, which the author considers to have been some what neglected, though it played a large part in influencing the policy of Napoleon III. The book opens with a survey of the economic conditions of France before the Revolution of 1848, and of the growth of railways, banks, and joint-stock enterprise during the succeeding years. Later chapters relate to the Bank of France, the part it played in financing railway extension in France, and its relations with the Treasury. There is also a short account of the old private banks and of the founding, under Government patronage, of the "Comptoir d'Escompte" and of the "Crédit Foncier," the purpose of which was to enable house- and land-owners to raise money on mortgage at low interest. A short account of the principal banks and credit institutions founded during the period, and of the Paris Bourse, completes the volume. There is an Appendix of statistical tables and a bibliography.]

Faxre-Gilly (Charles). La Politique des Prix Fixes: le controle du producteur sur le prix de revente de ses produits: sa valeur légale. xi + 206 pp. Paris: Marcel Giard, 1925. Price 18 frs.

[A comparative legal study of the economic origins and present extent of price-fixing in the United States and in England, and of the efforts that have been made by the legislatures to control it. The subject has received little attention in France owing to its slight development in that country, but the author is of opinion that such legislation as already exists there is sufficient for the regulation of prices.]

Gadgil (D. R.). The Industrial Evolution of India. xix + 242 pp. Humphrey Milford, Oxford University Press, 1924. Price 7s. 6d.

[Mr. Gadgil's monograph is a sketch of the economic history of India from about 1860 to 1914, since when economic conditions have not been sufficiently normal to admit of comparison with a pre-war period. The history falls into three successive periods—prosperity, adversity, and fair prosperity—which correspond with agricultural cycles and also with three distinct stages in the industrial progress of India. The gradual and inevitable change from old to modern industrial conditions is traced, and also its relation to the decline in handicrafts. The development of the railway system and its far-reaching effects are also fully discussed. There is a bibliography and index.]

Giddings (Franklin H.). The Scientific Study of Human Society. vi + 247 pp. Chapel Hill: University of North Carolina Press; and London: Humphrey Milford, 1924. Price 9s. net.

[An endeavour to show to what extent sociology is a scientific study of human society and how it can be made more so by quantitative research. Portions of the book have already been published in periodicals, including Chapter XII, on the Methods of Measurement, which is reprinted from the Publications of the American Statistical Association. This and the preceding chapters afford a useful outline for the statistical study of social surveys. There is a bibliography and index.]

Information Bureaux and Special Libraries. Report of Proceedings of the First Conference, 1924. 107 pp. 1925. Price 3s. 6d.

[An account of the first conference on specialized libraries and information bureaux, held at Hoddesdon in September, 1924. The papers read

and discussed covered a wide and useful field, including the collection, classification and distribution of records; types of special libraries, their functions, scope, and relation to other libraries; and the technical press. As a result of the conference, a representative standing committee was appointed and they have issued this report. It was decided to hold a second conference, which met at Oxford in September last, and a report will be published in due course.]

Lever (E. H.), F.I.A. Foreign Exchange from the Investor's Point of View. vii + 106 pp. London: C. and E. Layton, 1925.

[Mr. Lever's book consists of four lectures delivered at the Institute of Actuaries during the session 1924-25. A complete description of the theory of foreign exchange is not attempted, the lectures being limited in scope and designed mainly for students working for the examinations of the Institute and for actuaries who have to deal with investment in connection with assurance business. Particular attention has been devoted to the causes of fluctuations in rates. The lectures form a valuable survey of the forces which actuate exchange rates and will be welcomed by many besides those for whom they were primarily intended. Attention may be especially drawn to the sections dealing with purchasing power parity and its failure as a reliable means of forecasting exchange movements, and with forward exchange. An appendix gives a résumé of conditions prevailing in June, 1925, in gold standard countries.]

McBain (A. G.). Complete Practical Income Tax. ix + 253 pp. London: Gee and Co., 1925. Price 7s. 6d. net.

[An endeavour to supply the practising accountant and the business man with a concise and practical explanation of the Income Tax Acts and regulations. The book is also intended for the use of Final Examination students of accountancy, and a large portion is devoted to examples and their explanations. In the twenty-two chapters every phase of the income tax, also Dominion income tax, and super-tax, are described in as simple language as this increasingly complex subject allows. There is a good index. Attention is called to the fact that certain sections of the book, which was issued before the passing of the Finance Act, 1925, need modification in accordance with the new provisions.]

Meek (C. K.). The Northern Tribes of Nigeria. An Ethnographical Account of the Northern Tribes of Nigeria, together with a Report on the 1921 Decennial Census. 2 vols. Oxford University Press. London: Humphrey Milford, 1925. Price 36s. net.

[This work is in the main an elaborate ethnological and anthropological investigation of the numerous tribes of Nigeria, the census report and data being relegated to a secondary position. In view of the rapid changes taking place in the whole social life of these people, it was deemed advisable by the Government, when preparing for the Census of 1921, to include in the inquiries of the Census officers as much ethnographical information as possible, and thus to record the main facts of the economic life and industries, social organization, government, religions, and languages of a primitive people in a state of transition, before they were forgotten. The first Census of the Northern Provinces, taken in 1911, was merely an estimate of population by sex. That of 1921 was much more ambitious in its scope, though it claimed only approximate accuracy. It embraced density and race, age and sex, occupations, religions, and degree of education. The book has several maps, is profusely and well illustrated, and has an adequate index.]

Sée (Henri). L'Évolution de la Pensée politique en France au XVIII^e Siècle. 398 pp. Paris: Marcel Giard, 1925. Price 25 frs.

[Professor Sée's book is a complement to his earlier work published in 1920, which consisted mainly of extracts from the political writers of the period under review. The present work is in the nature of a synthesis of these writings and includes, besides, many subjects not treated in the earlier work. It is in five parts, the first dealing with the origins of political opinions prevalent in the eighteenth century and with the influence thereon of the writings of Locke and Bolingbroke. The second and third parts relate respectively to the liberal school of thought as expounded by Montesquieu, d'Argenson and Voltaire, and to democratic opinion as expressed by Rousseau and Diderot. The fourth examines the writings of the reformers, namely, those of the Physiocrats, and of Helvetius, d'Holbach and Turgot. In the final section, the author discusses the growth of the revolutionary spirit and the extent to which it was influenced by Mably, Condorcet, and the Abbé Raynal. The book lacks an index, but the full table of contents serves the purpose to a considerable degree.]

Southern Rhodesia, Official Year-Book of the Colony. No. 1, 1924. xvi + 329 pp. Salisbury, 1924. Price 7s. 6d.

[The first issue of this year-book coincides with the new form of government of Southern Rhodesia and its contents are, appropriately, historical to a large extent. The difficulties of the past and the method of their overcoming are briefly dealt with and the present position of the colony is examined. The thirty-nine chapters cover the whole field of administration, finance, production, and distribution, and the numerous statistical tables give the latest information available, and are retrospective so far as the records permit. There are several maps and a good index. The book will be most useful for purposes of reference.]

Spalding (W. F.). A Primer of Foreign Exchange. 2nd edition. 113 pp. London: Sir Isaac Pitman and Sons, 1925. Price 3s. 6d.

[Mr. Spalding's Primer was first issued in 1919 at the request of a number of bankers and others who were desirous of a short treatise on the exchanges in simple language. Since publication various suggestions have reached the author, and these have been embodied in the new edition as far as possible. A short account of forward exchange has also been added.]

Wolman (Leo). The Growth of American Trade Unions, 1880-1923: with a Foreword by Wesley C. Mitchell. 170 pp. New York, 1924. Price \$3.

[This volume, issued by the National Bureau of Economic Research, is a report on the trade union movement in America. As the "Foreword" tells us, the present survey makes no claim to precision, the figures given being "approximations rather than accurate determinations," since statistics of membership in trade unions and other data needful for exact information are defective. The author gives a useful and interesting account of the changes in union membership in the period 1880-1923, and touches on the struggle for supremacy between the Knights of Labour and the American Federation of Labour in the middle 'nineties. One chapter is devoted to a comparison of the extent of labour organization in the years 1910 and 1920, and another, dealing with the question of women in trade unions, shows that a remarkable increase in the number

of women members has taken place during the decade 1910 to 1920. An appendix consisting of nine tables gives, together with other statistical details, the number of persons employed in different industries and occupations and the percentage organized. There is a good index.]

Woo (James). Le Problème Constitutionnel Chinois. La Constitution du 10 octobre, 1923. 20 + 150 pp. Paris: M. Giard, 1925. Price 15 frs.

[An historical and legal study of the events leading up to the promulgation of the Chinese constitution of October, 1923. In tracing the constitutional movement in China the author shows that its origin was largely due to foreign influence. This was noticeable in various directions, as, for example, in the effect of Western mentality on Chinese students in European and American universities, and, again, in the success of Japan in the war of 1904-05, attributable, in Chinese opinion, to her adoption of a parliamentary régime. The many difficulties in the way of drafting a constitution for a country composed of such diverse elements—both ethnical and political—are dealt with at length by the writer. A French translation of the text of the Constitution is given in full, with annotations, and there is a list of Chinese words with the approximate French pronunciation.]

Young (John P.). Central American Currency and Finance. xviii + 258 pp. Princeton: University Press, 1925.

[A study of the currency systems and recent financial developments of the five states of Central America and of their financial relations, more especially those with the United States. The monetary experiences of these countries have been widely different and afford a good opportunity for the study of the working of fundamental monetary laws under varied conditions. Though the book is primarily for American readers the description of the present currency and banking systems of these countries will be of value to all interested in Central America. The appendices contain statistical tables and certain monetary laws, and there is a bibliography and index.]

CURRENT NOTES.

THE completion of the records of our external trade for 1925 enables us to survey the changes of the second half year, in relation to the data included in our last issue. Imports showed a rather remarkable falling-off in the third quarter of the year, but the movements of the final quarter were on a full normal scale. Exports of our own produce, which showed a drooping tendency in the first half of the year, recovered as the year advanced and, for the year as a whole, in spite of lower prices, were only about 3 per cent. less in value than those of 1924. In re-exports, an expansion of about 10 per cent. appears to be shown, but the greater part of this is attributable to the higher values per lb. of the rubber and, in a less degree, the wool re-exported in 1925 as compared with similar goods re-exported in 1924.

The comparison of 1925 with 1924, as shown in the declared values of imports and exports, is given in the following table :—

	Twelve months ended Dec. 31, 1925	Twelve months ended Dec. 31, 1924.	Increase (+) or decrease (—) in later period.
Imports, c.i.f.—	£'000.	£'000.	£'000.
Food, drink and tobacco	371,613	571,128	+ 485
Raw materials and articles mainly un- manufactured	425,209	400,019	+ 25,190
Articles wholly or mainly manufac- tured ...	319,840	299,774	+ 20,066
Other articles	6,196	6,518	— 322
Total imports	1,322,858	1,277,439	+ 45,419

	Twelve Months ended Dec. 31, 1925.		Twelve Months ended Dec. 31, 1924.		Excess (+) or Deficit (—) in later period.	
Exports, f.o.b.—	£ 000		£'000.		£'000.	
<i>United Kingdom Produce and Manufactures—</i>						
Food, drink and tobacco	54,997		56,957		— 1,960	
Raw materials and articles mainly unmanufactured	84,370		106,482		— 22,111	
Articles wholly or mainly manufactured	616,279		618,855		— 2,576	
Other articles....	17,440		18,672		— 1,232	
<i>Imported Merchandise—</i>						
Food, drink and tobacco	32,165		29,849		+ 2,316	
Raw materials and articles mainly unmanufactured	90,673		76,227		+ 14,446	
Articles wholly or mainly manufactured	31,464		33,742		— 2,278	
Other articles....	109		152		— 42	
Total exports	927,497		940,936		— 13,439	
Bullion and Specie—						
Excess of exports over imports	9,714		12,118		— 404	
Movements of shipping in the Foreign Trade:	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.
<i>Entered with cargoes—</i>						
British	31,965	37,968	30,719	36,856	+ 1,246	+ 1,112
Foreign	22,401	17,536	22,250	18,513	+ 151	— 977
Total	54,366	55,504	52,969	55,369	+ 1,397	+ 135
<i>Cleared with cargoes—</i>						
British	38,580	41,413	40,726	41,732	— 2,146	— 318
Foreign	22,200	20,897	25,463	23,566	— 3,263	— 2,669
Total	60,780	62,310	66,189	65,298	— 5,409	— 2,987

From the usual comparison made in the *Board of Trade Journal* of the values of the imports and exports of 1925 calculated at the average values of 1924, with the recorded figures for 1924 and for 1925, it appears that, in spite of such special features as the sensational increase in rubber prices, the volume of the import trade is very closely represented by its declared value in comparison with the figures of 1924. In the exports of domestic produce and manufactures, the price changes between 1924 and 1925 account for about four-fifths of the apparent reduction in trade, the falling-off in volume being well under 1 per cent. Re-exports have been so much affected

by price variation that the apparent increase in value represents a decrease in quantities of about 1·6 per cent. The following table summarizes the results indicated above :—

	1925. Values as declared	1925. Values on basis of 1924 prices	1924. Values as declared
Imports, total	£'00,000. 1,322·9	£'00,000. 1,321·1	£'00,000. 1,277·4
Exports—			
Of U.K. produce and manufactures	773·1	794·8	810·0
Of imported merchan- dise	154·4	137·8	140·0

The calculation of the non-material elements in the balance of payments due to or by the citizens of this country arising out of their trading and other relations with other countries involves a good deal of uncertainty. The different conceptions entertained in different countries as to the nature of the accounts involved in these calculations were made clear in the memorandum on the "Balance of Payments, etc.," issued by the League of Nations in 1924. The new edition of this memorandum includes, besides certain conclusions and calculations referred to below, further particulars regarding "invisible" imports and exports of various countries. The issue of the comparative statements contained in the first edition has contributed towards a greater uniformity in the conception of the problem to be solved which is traceable in the second issue. In the case of our own country, the *Board of Trade Journal* has published, with the estimates for 1925, a revision of the estimates for the two preceding years. The calculated excess of invisible exports over invisible imports, after taking account of payments between our own and other Governments, now given separately, is estimated at £348 millions for 1923, £387 millions for 1924, and £414 millions for 1925, the latter sum being £28 millions greater than the import excess in respect of merchandise and bullion and specie. The payments of commercial debts in 1925 in respect of goods sold in previous years, e.g. in 1919 or 1920, may, it would appear, add a substantial amount to the funds available for new investment abroad.

The survey of world trade in 1924, with some comparisons with other recent years and with 1913, given in the Memorandum of the League of Nations mentioned above, contains much that is of very great interest and importance. The broad comparison of the relative shares in international trade taken by different parts of the world in 1913 and 1924, based on a reduction of all values to their approximate equivalent in United States dollars, furnishes the following (abbreviated) comparison:—

Percentage Distribution of World Trade.

Group of countries.	Imports.		Exports.		Total.	
	1913.	1924.	1913.	1924.	1913.	1924.
Central and Eastern Europe	21·18	15·09	21·71	12·86	21·44	13·95
Other Europe	48·16	46·09	40·69	38·11	44·55	42·57
North America	12·23	16·33	15·83	22·16	13·96	19·15
Asia	7·14	9·81	7·84	10·36	7·48	10·08
Other countries	11·29	12·08	13·93	16·51	12·57	14·25
Total	100	100	100	100	100	100

Attention is particularly directed to the decreased percentages of the whole recorded against Europe and especially those parts of Europe in which the establishment of new inter-state frontiers might be expected to add to the record of international trade. The result is eloquent of the decreased volume of exchanges in these regions.

In the discussion of the data, the Memorandum gives some prominence to the conclusion that "it is probable that the total of world trade was not greatly different in 1924 and 1913," *i.e.*, not greatly different in volume. This conclusion is based on a comparison of the increase in the aggregate values, calculated in U.S. dollars, of imports and exports in the two years, showing an increase, after making certain corrections, of about 50 per cent., and the indications furnished by calculations, available for a number of countries, of average changes in export and import values in the interval. The latter, after making some discount on account of the presumed movement in the cases of countries for which no such estimates are available, appear to show an average price-rise of nearer 50 than 40 per cent. In this calculation, the rise in the U.S.A. values is stated on p. 89 as 68 per cent. for exports and 69 per cent. for imports,

and in the table on pp. 96-7, on which the aggregate calculation is apparently based, as 68 per cent. for exports and 42 per cent. for imports. The difference would be quite perceptible in the general average calculated.

While it is true that the data on which the broad general conclusion, which we have cited above, is reached cover some of the most important trading countries, there is so important a part of international trade for which the requisite calculations have not been made that there is room for a difference of opinion as to the probable measure of change in the volume of world trade, *i.e.* trade between countries. It may be noted that the United Kingdom exports are shown at 14.05 per cent. of world exports (so far as covered by the table given), in gold value, in 1913, and at 14.01 per cent. in 1924. The latter figure would be reduced, apparently, to 13.94 by the exclusion of our exports to the Irish Free State, and some further adjustments would be necessary, probably tending to reduce the percentage, in taking account of the corrections necessary for comparative purposes in the world total. The difference between the average increase of prices as calculated for our exports, and the 50 per cent. increase estimated in the Memorandum to represent the average increase in international trade in the bulk, may reconcile the figures published by the Board of Trade as to the reduction in volume of our export trade and the figures cited above in relation to the conclusion that the general volume of world trade has reached about the level attained in 1913. It is open to question, however, whether this conclusion does not overestimate the extent of the recovery in world trade by a substantial amount, perhaps not less than 10 per cent.

The gradual decrease in wholesale prices, as measured by the Board of Trade index-number, which had been proceeding since January, 1925, when the highest point for more than 3 years was reached, continued in the second half of last year, so that the average level of wholesale prices in December was 10.5 per cent. below the average level for January. In the second half of the year the fall was from 157.6 for average June prices to 153.2 for December prices, the basic period being that hitherto used by the Board of Trade for this purpose, *viz.*, the year 1913. The decrease in the total of items other than food was steady from July onwards, and although cereals and meat prices in the last two months of the year gave an upward movement to the total of the food items, this was not sufficient in either month to check the general downward tendency of the total index-number.

In reviewing the course of wholesale prices for the year 1925 the *Board of Trade Journal* substitutes average prices for 1924 as the basis of comparison. On this basis the general average for 1925 was 96.1, and the monthly variations in the total index-number during the year were between 103.0 in January and 92.2 in December. For articles of food the variations were between 107.8 and 98.5, and for industrial materials between 100.4 and 88.1. Both food and materials prices were at the highest level in January, but October was the month of lowest level for the former and December for the latter. If the average for 1913 be taken as 100 the total index-number average for 1925 was 159.7. The food total stood at 168.7, with meat and fish showing the least increase over 1913 (61.9 per cent.), and the miscellaneous group the greatest increase (79.1 per cent.). In the industrial materials total the average increase over 1913 was 54.9 per cent., the increases in the component groups ranging from 25.9 per cent. for iron and steel to 109.8 per cent. for cotton.

According to the *Economist* index-number of wholesale prices there was a break in the downward movement during the third quarter of the year, for standing at 197.8 at the end of June, the total index reached 202.3 two months later, but by the end of December it had fallen to 193.2, the lowest point reached since August, 1923. This compares with 220.7 at the end of 1924. To this reduction in 1925 all groups in the total contributed, but more than half of it was due to textiles. If the comparison be made with prices prevailing at the outbreak of war, the effect of the changes during the year is seen to be a general levelling out of prices. All the groups at the end of December, 1925, were less than 100 per cent. higher than in July, 1914, and the general level showed an increase of only 65.8 per cent., as compared with 89.3 per cent., a year before, and 225.6 per cent. at the end of March, 1920. In the average increase of 65.8 per cent. over July, 1914, prices at the end of December, cereals and meat, textiles and minerals price increases were grouped fairly near about the average, the greatest divergence being in other foodstuffs on the one hand (93 per cent.) and miscellaneous materials on the other hand (41 per cent.).

The *Statist* index-number of wholesale prices, which stood at 134.3 at the end of July, had fallen by the end of December to 130.4, as compared with 147.7 at the end of 1924, a net decrease for the year of 11.7 per cent. The average index-number for 1925 was

135·6; this was 2·4 per cent. below the average for 1924, 46·0 per cent. below that for 1920, the year of highest prices, and 59·5 per cent. above that for 1913.

The following table summarizes movements in the general level of retail prices in Great Britain and Northern Ireland, as estimated by the Ministry of Labour :—

	Percentage increase in prices since July, 1914	
	Food only. Per cent.	All items included in the budget Per cent.
August 1 . . .	68	73
September 1 . . .	70	74
October 1 . . .	72	76
November 1 . . .	72	76
December 1 . . .	74	77
January 1 . . .	71	75

A marked increase in the price of bacon in August emphasized the effect of seasonal increases in the retail prices of other foodstuffs, but in the next two months successive reductions in the price of bread and flour tended to check the aggregate seasonal increase. Somewhat early reductions in butter and egg prices were responsible for reversing the seasonal movement by a fall in retail food prices between December 1 and January 1 from 74 to 71 per cent. above the July, 1914, level. From the fact that the food items accounted for 60 per cent. of the total family budget in July, 1914, one can deduce the fact that between the dates covered by the table above the prices of other items included in the budget remained practically stationary at slightly over 80 per cent. above the prices ruling on July 1, 1914.

The following table summarizes for the chief countries the latest information as to retail prices overseas as reproduced in the *Labour Gazette*. The third column gives the percentage increase in retail food prices on those ruling in July, 1914, or some similar pre-war period; the fourth column gives the estimated percentage increase for all the items covered by the budget in each case, such

items, in addition to food, comprising generally rent, clothing, fuel and light, and other household requirements :—

Country.	Date of latest return.	Food.	All items.
<i>Foreign Countries.</i>		Percentage increase.	Percentage increase.
Belgium	December, 1925....	—	43·4
Denmark	July, 1925	110	119
Egypt (Cairo)	October, 1925 ...	—	64
France (Paris)	December, 1925....	363	301(3rd qr.)
„ (other towns) ...	November, 1925....	371	—
Germany	December, 1925 ...	—	41
Holland (Amsterdam)	September, 1925 ...	48	—
Italy (Milan)	December, 1925 ...	560	549
Norway	December, 1925...	121	134
Spain (Madrid)	October, 1925 ...	—	89
Sweden	December, 1925....	—	64
Switzerland	November, 1925....	63	65
United States	November, 1925.	64	74 (June, 1925)
<i>Overseas Dominions, etc.</i>			
Australia . .	November, 1925....	56	55(3rd qr.)
Canada	December, 1925....	61	54
India (Bombay)	December, 1925 .	51	55
Irish Free State	October, 1925 ...	88	88
New Zealand	November, 1925 ...	56	—
South Africa	November, 1925....	17	31

In continuation of statistics relating to employment in Great Britain and Northern Ireland, quoted on p. 633 of the *July Journal*, returns from trade unions with a total membership of approximately one million members, showed 11·2 per cent. of their members as unemployed at the end of July, 1925. A month later this percentage rose to 11·4, where it also stood at the end of September. It then fell to 11·3 and still further to 11·0 at the end of November, and remained unchanged at the end of the year. At the close of 1924 the corresponding figure was 9·2 per cent. With these figures may be compared the percentage unemployed among the number of workpeople, numbering at the end of the year 11,892,000, insured under the Unemployment Insurance Acts in Great Britain and Northern Ireland. Standing at 11·5 on July 27, this percentage rose more sharply than the corresponding trade union figure to 12·5 on August 24. It then fell till on November 23 it stood at 11·0 or exactly the same as the trade union returns a week later. The fact that on December 21 at 10·5 it fell below the trade union return for the end of the month may be explained by the fact that it represents probably at its maximum the seasonal employment

associated with Christmas traffic, etc., but it may be noted also that in contrast with the other return, this index of employment represents an improvement, even if a slight one, on the position of a year before, when the percentage was 10·7. Some indication of the magnitude of the aggregate figures corresponding to these percentages is given in the returns published by the Ministry of Labour showing the total number of persons registered at Employment Exchanges in Great Britain and Northern Ireland as unemployed at various dates. On July 27 this number was 1,262,000, and by August 31 it had risen to 1,418,000. Thereafter it fell to 1,401,000 on September 28, and then more rapidly till on December 21 it stood at 1,166,000. A comparison with the position of a year before, as reflected in employers' returns received by the Ministry of Labour, is given in the following table. The returns relating to coal-mining and to the iron and steel trades cover the whole month in each case.

Week ending	Coal-mining. Increase or decrease on a year ago in days worked per mine per week.	Iron and steel trades. Percentage change on a year ago in aggregate number of men-shifts.	Other trades covered by the returns. Percentage change on a year ago.	
			Numbers employed.	Wages paid.
July 25 ...	+ 0·44	- 6·2	- 1·5	-3·0
August 29 ..	- 0·69	- 8·8	- 1·3	-2·8
September 26	- 0·59	- 7·6	- 1·7	-2·8
October 24 ...	- 0·25	- 4·6	- 1·2	-1·1
November 28 .	- 0·11	- 3·1	- 0·4	+0·6
December 19 ...	+ 0·10	- 1·2	- 0·8	- 1·1

In a review of employment and wages during 1925 in the *Labour Gazette* for January, it is stated that employment continued bad, on the whole, during the year, and was rather worse than in the previous year, the average of the monthly percentages unemployed in Great Britain and Northern Ireland, among workpeople covered by the Unemployment Insurance Acts, being 11·3 in 1925, as compared with 10·3 in 1924. This increase was mainly due to the severe depression in the coal-mining industry, in which the numbers of unemployed averaged 198,000 in 1925, as compared with 72,000 in 1924. In other industries, taken as a whole, the average number unemployed in 1925 was approximately the same as in the previous year, although in the wool textile industry, in which employment was bad throughout the greater part of the year, the average number of insured workers unemployed was greater by about 19,000 than in 1924. At the end of the year the

numbers of insured workers recorded as unemployed in industry as a whole were slightly lower than in December, 1924, notwithstanding an increase (estimated at 228,000) in the total number of insured workers between July, 1924, and July, 1925. The proportions of insured workers recorded as unemployed in Great Britain and Northern Ireland in December of each of the years 1921 to 1925, the period for which comparable data are available, were as follows :—

December, 1921	...	...	...	...	17·9 per cent.
„ 1922	...	...	...	...	12·8 „
„ 1923	...	...	...	...	10·6 „
„ 1924	...	...	...	...	10·7 „
„ 1925	...	...	...	...	10·5 „

The trade union returns provide a longer series of data. The mean of the 12 monthly percentages of unemployment for each year since 1910 are given in the following table :—

1910 .. 4·7	1914 3·3	1918 0·8	1922 15·2
1911 .. 3·0	1915 ... 1·1	1919 2·4	1923 11·3
1912 .. 3·2	1916 . 0·4	1920 . 2·4	1924 ... 8·1
1913 2·1	1917 . 0·7	1921 .. 14·8	1925 10·5

The number of trade disputes of any significance causing stoppage of work, reported to have begun in 1925 in Great Britain and Northern Ireland, was 601. The total number of workpeople involved in these stoppages (including those workpeople thrown out of work, though not actually on strike or locked out, at the establishments where the disputes occurred) was about 438,000, and a further 3,000 workpeople were involved in 25 disputes, which began in 1924 and continued into 1925. The aggregate number of working days lost by these workpeople in the disputes was approximately 7,976,000; this total is the lowest recorded for any year since 1918.

The numbers of workpeople affected by changes in rates of wages, and the net effect of the changes on the general level of wages, were smaller in 1925 than in any year since 1914. In the industries and services for which the Ministry of Labour presents figures the changes reported during the year resulted in an aggregate net increase of about £80,000 in the full-time weekly wages of nearly 900,000 workpeople, and in a net decrease of about £160,000 in those of approximately 850,000 workpeople. In comparison with

these figures, in 1924 approximately 3,000,000 workpeople received net increases amounting to £616,000 a week, and about 480,000 sustained a net decrease of £62,000 a week. These figures, it should be observed, exclude, among others, agricultural workers, large numbers of whom obtained increases in rates of wages in 1925. If changes in the wages of agricultural workers were included in the statistics, the total for all industries would show a slight increase in weekly wages in 1925, instead of the slight reduction indicated in the figures already quoted. When account is taken of all the information available to the Ministry of Labour, including the changes in agricultural wages, it would appear that at the end of 1925 weekly full-time rates of wages averaged between 1 and 2 per cent. higher than at the end of 1924 and about 75 per cent. higher than in August, 1914. These figures, of course, relate to rates of wages for a full normal week, and take no account of changes in earnings resulting from alterations in the state of employment, the effect of which varied in different industries. Changes in normal hours of labour reported in 1925 affected 5,000 workpeople, of whom 1,200 had their hours increased by an average of $2\frac{1}{4}$ per week, and 3,800 had their hours reduced by an average of nearly 4 per week.

Official statements as to employment in Germany, as summarized in the *Labour Gazette*, show that in addition to the seasonal increase in unemployment in the latter part of 1925, there were definite signs of a tendency towards a contraction in industrial employments. Returns from 40 trade unions with a total membership of over $3\frac{1}{2}$ millions show an increase in the percentage of members returned as unemployed from 3.5 at the end of June, to 5.8 at the end of October. In the case of Norway the latest returns quoted by the *Labour Gazette* relate to the end of October, when the percentage of unemployed in the trade union returns was 17.0. This was more than double the lowest figure for the preceding months of the year, viz., 8.1 per cent. at the end of May, and compared still more unfavourably with a return of only 5.8 per cent. for the end of October, 1924. For Swedish trade unions, returns were given up to the end of November, when the proportion of unemployed was 11.8 per cent., which is only slightly in excess of that of a year before, viz., 10.5 per cent., and shows a comparatively small increase on the figure of 7.8 per cent. for the end of May. In the third Scandinavian kingdom returns supplied to the Danish Statistical Department by trade unions and by the Central Employment

Exchange showed a seasonal expansion in the proportion of unemployed from 8.3 per cent. at the end of July to 12.7 per cent. at the end of October, when it made a sudden upward sweep to 18.3 per cent. at the end of November, which left it at double the figure for the end of November, 1924.

In Canada the index-number of employment, based upon returns received by the Dominion Bureau of Statistics from nearly 6,000 firms, employing over three-quarters of a million of workers, rose steadily from 94.5 on June 1, to 98.3 on October 1. This movement was confirmed by a contraction of the trade union percentage of unemployment over the same period from 7.0 to 5.7. On November 1 the index had fallen slightly to 97.1, but this still left a favourable comparison with a year before when it stood at 90.2. The monthly report on employment issued by the Federal Department of Labour Statistics at Washington is now based upon returns received from over 9,400 establishments in 53 industries and covers nearly 3 million workers. In each of the months of June and July there was a decrease of 1.1 per cent. in the numbers employed, but in each of the following four months there were increases ranging from 0.2 to 2.2 per cent. If the monthly average index-number of employment in manufacturing industries in 1923 be taken as 100, the corresponding index-number for June, 1925, was 90.1. Falling to 89.3 in July, it rose steadily till in November it reached 92.5, as compared with 87.8 for November, 1924.

This month the editors of the *Economic Journal* have issued a special supplement which initiates a new enterprise on the part of the Royal Economic Society. The whole number is devoted to Economic History, and comprises twelve papers on very varied subjects, each being a detailed investigation of a single patch of the historical field. The publication opens very appropriately with an article by Professor E. E. Muntz on the Early Development of Economic Concepts, but most of the contributions are concerned with actual data; they include studies of the cotton market in 1799, the consumption of tobacco since 1600, the Potteries in the industrial revolution, also several dealing with agricultural matters. We may express the hope that this interesting venture will receive sufficient support to warrant the continuation of the series, the anticipation of which is indicated by the editors in a prefatory note.

Departmental Bulletin No. 1300 of the United States Department of Agriculture, entitled *Corn and Hog Correlations*, illustrates the enterprise of that Department in applying modern statistical methods to a problem of absorbing agricultural interest. The old saying that pigs are either gold or muck still applies in this country, and the uncertainties indicated by this old saw are still doing much to hinder the expansion of pig-breeding here. In this country the factors governing the supply and price of pig-meat may be even more complicated, including as they do so many considerations based upon imported supplies, but there are certain similarities in this problem in the two countries which render this study of direct interest to British agriculturists. It represents an attempt to analyse the play of interacting factors responsible for the annual fluctuations in production and price of hogs in the United States during the period of relatively stable conditions between the Civil War and the World War. The basis of the study is provided by a tabulation of the annual fluctuations about the trend over the period covered for corn (maize) acreage, yield, crop, and price, the number, carcase-weight, and price of the summer and winter packs in the eastern and western States respectively, and the farm price of hogs. All the possible correlations among these variables are calculated, and an attempt is made to find the system of causal relations that would best account for the observed correlations. Finally, a series of formulæ is given for predicting the fluctuations of each variable, with discussions of the limitations. The dominating features of the hog situation in the United States are shown to be certain effects of the maize crop and price, and a tendency to fall into a cycle of successive over-production and under-production, two years from one extreme to the other. It is pointed out that if these unfortunate oscillations are to be avoided, pig-breeding must be based on a sounder vision of prospective conditions than can be obtained from the memory of past profits. To the British farmer also this is a true saying but a hard one—who will attempt to interpret it for him?

The Society have received from the Russian Academic Organization in Prague a copy of the *Mélanges Pierre Struve: recueil des écrits présentés à M. Pierre Struve le 30 janvier, 1925*, being a volume dedicated to Professor P. B. Struve, the eminent Russian economist, on the occasion of his completion of thirty-five years of scientific and literary work. The varied and interesting contents of this volume of some 450 pages cover a wide range of subjects,

from Economics and Statistics to History, Jurisprudence, Philosophy, and Religion, all subjects in which Professor Struve takes more than a superficial interest. Among the articles on Statistics and Economics there is one by Mr. O. Anderson, in which he deals with the variate Difference Method, continuing the investigations embodied in his articles in *Biometrika*, and promising a monograph on the problem; and one by Professor A. Tschuprow, dealing with the problem of value in connection with the "statistical theory of prices" expounded by Professor Struve in his treatise on "National Economy and Price."

Those Fellows who have not observed a letter which appeared in *The Times* of November 17 last will be interested to learn of the scheme which is on foot for a memorial to the late Sir William Acworth; a committee under the chairmanship of Lord Ashfield is in charge of the scheme. The form of the memorial has not yet been definitely decided, but it is anticipated that it will be related to his work at the London School of Economics. Further details will, we understand, be made public very shortly.

OBITUARY.

SIR ATHELSTANE BAINES, C.S.I.

By the death on November 26, 1925, of Sir Jervoise Athelstane Baines the Society has lost one of its most eminent and energetic Fellows. Born in 1847, he was educated at Rugby and Trinity College, Cambridge, and passed the Indian Civil Service examination in 1868. The earliest attempt to enumerate the population of India was made during the five years 1867 to 1872, and when the first synchronous Census was undertaken in 1881, Mr. Baines was deputy-superintendent in the Western Presidency. The aptitude and ability he then displayed led to his appointment as Census Commissioner for the whole country at the second decennial Census in 1891. His report on that Census, as *The Times* observes, "still takes a high place in the literature of ethnography." The phrase justly indicates the breadth of view which was characteristic of the author as a statistician. Then as in all his subsequent work he brought to the presentation and interpretation of statistical data not only all the resources of a well-stored mind but also a gift of sympathetic insight which enabled him to develop with almost dramatic vividness "the story behind the figures." The glamour of India which caught him in his early days never quite left him, although he retired from the Indian Service in 1895 and plunged zealously into the prosaic atmosphere of English politics and local administration. His last official work for India was as secretary of the Opium Commission in 1894-95. On retirement he was awarded the C.S.I. For some years he lived in London and took an active part in the work of the London County Council of which he was an Alderman. He settled at Kidlington, Oxon, in 1904, and served on the Oxfordshire County Council from 1917 to 1922, taking a special interest in educational work. He also took an active interest in the work of Friendly Societies and their organization. He received the distinction of Knighthood in 1905.

Elected a Fellow of the Society in 1881, Sir Athelstane Baines served continuously on the Council from 1895 to 1909, when he was elected President. From 1896 to 1909 he was one of the honorary

secretaries, for the last seven years of that period being also honorary foreign secretary. In 1900 the Guy Medal in gold was awarded to him for his services to statistical science and for his special services to the Society. His contributions to the proceedings of the Society were numerous, beginning in 1893 with a paper on "The distribution and movement of the population of India," and ending in 1924 with a paper on "The International Statistical Institute and its Fifteenth Session." His formal contributions were mainly demographic, but his interventions in the discussions at the Society's meetings were not only welcomed for their incisiveness and humour, but also demonstrated his grasp of statistical method and the versatility of his statistical interest.

Sir Athelstane Baines was elected a member of the International Statistical Institute in 1897 and attended the Sessions in 1899, 1903, 1905, 1907, 1909, 1911 and 1923. He took an active part in the proceedings of the Institute and was on more than one occasion appointed Chairman of one of the Sections. He was an Honorary Member of the American Statistical Association.

R. H. R.

Among the varied and valuable contributions to Statistics of our late friend and colleague, it is probable that his work in connection with the Census of India will stand out most prominently. Anyone with a nodding acquaintance with Census work will recognize,—those familiar with its difficulties will admire—the remarkable nature of what is accomplished in the taking of the Census of India. The unique position which its reports hold in Census literature was largely due to the inspiration and impetus given to it by Sir Athelstane Baines.

At the first general Census of India in 1881 he held the post of Superintendent of Census for Bombay; at the second, ten years later, that of Census Commissioner, and the striking success of the latter was in great measure due to the infinite interest and knowledge which he brought to bear upon its manifold demands.

The Indian Census of 1891 broke away from its predecessor in two important particulars—first the separation of caste from religion and, secondly, the substitution of the population *subsisting* by an occupation for that *exercising* it. In both of these cases the scheme of classification was the work of the Census Commissioner.

The General Report of some 300 pages came entirely from his pen. Written, as it was, in this country, beyond the possibility of consultation with other branches of the administration, it is a veritable *tour de force*. Looking at it again to-day one is struck

with admiration for the way in which the great opportunity was seized, and for the breadth of conception, perfection of organization and executive ability which it reveals. And those of us who have been condemned to couch our Reports in the drab, dull and precise phraseology so dear to one type of officialism must also feel a touch of envy at the literary flavour and the wide scholarship which permeate it.

Of this Report one might say, without straining the quotation,

“Si monumentum requiris, circumspice.”

It is indeed a fitting monument to one who combined with a wholehearted devotion to statistical science a rare ability and a personality whose charm endeared him to everyone with whom he came in contact.

S. DE J.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS.

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Accountants' Magazine. December, 1925—Some notes on diversions of capital: *Ker (Charles)*.

Bankers' Magazine—

August, 1925—The banking half-year. Profits and their distribution. The problem of "transfers."

September, 1925—Britain's industrial crisis. The future of Brazil. The gold standard: *Leaf (Walter)*.

October, 1925—Proportion of cash to callable liabilities. Gold: in the Great War and since: *Liversedge (A. J.)*.

November, 1925—The proportion of capital and reserves to deposits. The use and abuse of price index-numbers.

December, 1925—The fallacies of socialism: *Steele (F. E.)*.

January, 1926—Post-war progress. Europe after the war: *Harvey (Sir Ernest Maes)*. Practice and theory in banking: *Steele (F. E.)*. Indian banking and monetary progress: *Blackett (Sir Basil)*. United States gold demand.

East India Association, Journal of. October, 1925—Recent progress in India: *Webb (Sir M. de P.)*.

Economica. November, 1925 The records of a pin manufactory, 1814-21: *Ashton (T. S.)*. The labour bank movement in the United States: *Kilborne (Russell D.)*. A note on the steel industry of India: *Slater (Dr. Gilbert)*.

Economic Journal—

September, 1925—Discussion on the national debt by *Dalton (Dr. H.)*, *Macgregor (Prof. D. H.)* and others. Saving and the monetary system: *Bickerdike (C. F.)*. The plurality of index-numbers: *Edgeworth (Prof. F. Y.)*. The agricultural argument: *Macgregor (Prof. D. H.)*. A study of London's retail meat trade: *Dunlop (W. R.)*. The position of Russian agriculture: *Tcherkinsky (M. N.)*. Government storage of corn: *Thompson (H. M.)*.

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Faculty of Actuaries, Transactions of. No. 97, 1925—Notes on graduation—abstract of discussion : *Buchanan, (James)*. D.Sc

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April–June, 1925—The industrial outlook : *Marlow (John)*.

The position of iron and steel companies : *Gardner (J.)*.

Pros and cons in our textile industries : *Anderson (S. N.)*

July–September, 1925—The meaning of capital exports : *Lever*

(*E. A.*). France and her financial problems : *Brun (Henry)*.

Economic conditions in Central Europe : *Meicer (Atherton)*.

Recent developments of the anthracite coal-mining industry in South Wales and its future prospects : *Keishaw (J. B. C.)*.

International iron and steel trades : *Good (E. T.)*.

Institute of Actuaries, Journal of—

July, 1925—Notes on life assurance investment policy : *Coutts*

(*C. R. V.*). On the calculation of contingent assurances and

the compound survivorship annuity when Makeham's Law holds : *Evans (A. W.)*. On a problem of apportionment :

Carter (N. J.)

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value and the standard of deviation of a life annuity based on

a given experience : *Tanner (Thomas)*. Note on H. L.

Trachtenberg's method (No. 1) of valuing policies in groups :

Polden (L. S.).

Institute of Bankers, Journal of—

November, 1925—British home banking since 1911 : *Fruser*

(*Sir D. Drummond*). The advantages and disadvantages of

amalgamation and centralisation in business : *Devereux*

(*H. E.*).

December, 1925—Inaugural Address of the President : *Ferguson*

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mark. II. Denmark : *Ruston (A. G.)*. Field Experiments at

Rothamsted during 1923 and 1924 : *Russell (Sir John)*.

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(*A. W.*) and *Jones (J. Morgan)*.

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Secretary. December, 1925—An index of production: *Layton (W. T.)*.

Statistical and Social Inquiry Society of Ireland, Journal of.

October, 1925—Some perplexities in regard to the agricultural statistics of Ireland: *Oldham (Prof. C. H.)*. The interpretation of Irish statistics: *Oldham (Prof. C. H.)*. The housing problem in Ireland and Great Britain and the essentials of its solution: *Maguire (J.)*. Methods of sampling applied to Irish statistics: *Geary (Robert C.)*. The trade statistics of the Irish Free State in 1924: *Lyon (S. G.)*, *Eason (J. C. M.)*, and others.

Surveyors' Institution, Journal of—

August, 1925—Arterial road planning and housing in the Liverpool area: *Kelly (Sydney A.)*.

September, 1925—Compulsory purchase of land for public purposes: *Burch (Herbert)*.

January, 1926—The weather and the wheat crop, 1925: *Sanctuary (C. T.)*. Basis of valuation for rating in Ireland, United States and Belgium: *Mills (A. E.)*.

AUSTRALASIA—

The Economic Record, No. 1, Vol. I. November, 1925—Australian population: its nature and growth: *Wickens (C. H.)*. The Australian tariff and the standard of living: *Brigden (J. B.)*. Wages and production: *Sutcliffe (J. T.)*.

INDIA—

Indian Journal of Economics. April, 1925—Papers read and discussed at the Eighth Conference of the Indian Economic Association, including "The growth of taxation in relation to population and prices," by *Hamilton (C. J.)*; "The Indian system of taxation," by *Hasan (Anwarul)*; "The function of income-tax in the fiscal system of India," by *Chand (Gyan)*.

UNITED STATES—

American Academy of Political and Social Science, Annals of—
*September, 1925—*A series of articles by various authors on new values in child welfare.

*November, 1925—*A series of articles by various authors on the Far East.

American Economic Review, Supplement—

*September, 1925—*Fiduciary powers of national banks : *Tippett* (Charles S.). Price margins during a period of prosperity : *Loucks* (W. N.). Income and wealth : *King* (Willford I.). Forecasting the price of hogs : *Sarle* (Charles F.).

*December, 1925—*What has the Federal Trade Commission accomplished ? *Stevens* (W. H. S.). Computation of goodwill profits : *Foreman* (C. J.). Influence of interest rate on the business cycle : *Snyder* (Carl).

American Statistical Association, Journal of—

*September, 1925—*On the true rate of natural increase : *Dublin* (Louis I.) and *Lotka* (Alfred J.). A general mathematical theory of depreciation : *Hotelling* (Harold). A New Zealand study in infant mortality : *Neale* (Edward P.). Variability of family strains in the negro-white population : *Herskovits* (Melville J.). A form of saturation curve : *Reed* (Lowell J.). The revised index of the volume of trade : *Snyder* (Carl).

*December, 1925—*The logarithmic curve of distribution : *Davies* (George R.). Variation and correlation within the credit structure : *Falkner* (Helen D.). Measures of correlation determined from groups of varying homogeneity : *Kelley* (Truman L.). An index-number of net foreign trade in foodstuffs : *Arner* (George B. L.). Error in eliminating secular trend and seasonal variation before correlating time series : *Smith* (Bradford B.). Statistics as an aid in maintaining quality of a manufactured product : *Shewhart* (W. A.). Quantitative determination of fundamental changes in economic data : *Gressens* (O.).

*Harvard Business Review. October, 1925—*The Indian market for cotton goods : *Jones* (Owen). Financing the marketing of wheat : *Chapman* (John M.). Coal-mining and the business cycle : *Crum* (William L.) and *Vanderblue* (Homer B.).

Land and Public Utility Economics, Journal of—

*July, 1925—*Public utility financing, 1919-25 : *Dorau* (Herbert B.). Relationships of landlords, to farm tenants : *Buechel* (F. A.). The public control of house rents : *Whitman* (Marcus). Summaries of research. Multi-family housing units and urban tenancy : Dividend record of gas utilities : *Maas* (W. G.).

*October, 1925—*Commercial vehicles on free highways : *MacDonald* (T. H.). Influence of customer ownership on utility financial structure : *Bruner* (Henry P.).

UNITED STATES—*Contd.*

Journal of Political Economy—

August, 1925—The utility concept and its critics : *Viner (Jacob)*.

October, 1925—The statistical law of demand. I: *Schultz (Henry)*. Marginal productivity : *Knight (F. H.)* and *Clark (J. M.)*.

December, 1925—The statistical law of demand. II: *Schultz (Henry)*.

Quarterly Journal of Economics—

August, 1925—Recent literature on British Unemployment Insurance : *Tolles (N. A.)*. The coal situation and the coal parliament : a rejoinder : *Orchard (John E.)*. Consumers' demand : *Angell (James W.)*. The static and dynamic view of economics : *Kondratieff (N. D.)*. The statistical determination of demand curves : *Working (Holbrook)*.

November, 1925—German industrial organization since the world war : *Liefmann (Robert)*. Railroads : recent books and neglected problems : *Ripley (William Z.)*. Review : Edgeworth's Papers relating to Political Economy : *Fisher (Irving)*.

The Record—*American Institute of Actuaries*. June, 1925—On Lidstone's Demonstration of the Osculatory Interpolation Formula : *Reilly (J. F.)*.

Review of Economic Statistics—

July, 1925—Review of the second quarter of the year. Statistics and economic theory : *Persons (Warren M.)*. Some price-determining factors in the iron industry : *Blackett (Olin W.)*. The physical volume of production in the U.S.A. for 1924 : *Matthews (Ada M.)*.

October, 1925—Review of the third quarter of the year. A weekly commodity price index : *Snider (Joseph L.)*. An index of general business conditions for Germany, 1898-1914 : *Wirtz (Emerson)* and *Flinn (Harold M.)*.

ARGENTINA—

Revista de Ciencias Económicas—

January-February, 1925—La economía de la empresa (Su estudio en la Universidad Alemana) : *Coutre (Walter le)*.

March-April, 1925—Apreciaciones sobre el estado actual de nuestro régimen agrario : *Ciricano (Miguel A.)*.

June, 1925—Apuntes sobre el cálculo de las probabilidades : I : *Galé (José G.)*.

July, 1925—Apuntes sobre el cálculo de las probabilidades : II : *Galé (José G.)*. Las hipótesis de Pearl y Reed sobre el crecimiento de la población : *Acerboni (Argentino V.)*.

August, 1925—Datos estadísticos sobre el costo de los transportes : *Tajani (Filippo)*.

DENMARK—

Nationaløkonomisk Tidsskrift—

Hefte 3-4, 1925—Samhällets Ställning til Arbets- och Varumonopolen : *Ohlin (Bertil)*. Indkomstfordelingens Afhængighed af økonomiske Forhold : *Zeuthen (F.)*. Midler til at stabilisere og hæve Kroneværdien : *Bech (Gustave O.)*.

Hefte 5-6, 1925—Den Amerikanske Dollar, 1914-24 : *Riis-Hansen (K.)*. Den Danske Skov som Formuegenstand og Produktionsfaktor : *Grøn (A. Howard)*. Arbejde og Kapital : *Mørup (E.)*.

EGYPT—

L'Égypte Contemporaine. November, 1925—L'essor industriel de la Palestine : *Anhoury (J.)*.

FRANCE—

Bulletin de Statistique et de Législation Comparée. June 1925—Statistique des voitures publiques soumises à l'impôt indirect en 1924.

Journal de la Société de Statistique de Paris—

July-August-September, 1925—Essai statistique sur la valeur du franc : *Royot (Emile)*.

October, 1925—Sur une statistique internationale de la production dans les industries soumises aux droits d'accises : *Julin (Armand)*. Le recensement général du Portugal en 1920 : *Béthencourt (J. de)*.

November, 1925—La statistique des familles norvégiennes au recensement de 1920 : *Bourdon (Jean)*.

December, 1925—Nos pertes de guerre, leurs réparations et nos dettes de guerre (à suivre) : *Cadoux (Gaston)*.

Journal des Economistes—

October, 1925—Conséquences économiques du règlement des réparations et des dettes interalliées : *Yves-Guyot*. De la défense juridique du franc : *Dreyfus (Albert)*. Observations d'un Américain sur la dette française aux Etats-Unis : *Godchot (Col.)*. Les récoltes actuelles et les ressources de l'Europe : *Mondet (N.)*.

November, 1925—Le projet d'assainissement financier : Recherches statistiques sur la discordance des changes inverses : *Pietri-Tonelli (Alfonso de)*. La pétrole, la houille et la force hydraulique : *Pierre (R.-J.)*. La XVI^e Session de l'Institut International de Statistique : *Bernonville (L. Dugé de)*.

December, 1925—La justification des inquiétudes de l'homme moyen : *Yves-Guyot*. Government Publications : *Legros (J. B.)*.

La Réforme Sociale—

July-August, 1925—Visions du paradis bolchevique—Communication de *Alexinski (G.)*. Articles on communism by *Aucuy (M.)*, *Gautherot (Gustave)* and *Barde (M. l'Abbé)*.

FRANCE—Contd.

La Réforme Sociale—Contd.

September–October, 1925—L'expérience bolchevique : *Triboulet (M.)*. Les causes historiques du bouleversement de la Russie : *Suligowski (A.)*.

November, 1925—Les réformes agraires en Europe depuis la guerre : causes et tendances : *Jousse (P.)*. Efforts et effets du communisme agraire dans le pays des Soviets : *Zvorikine (Nicolas)*.

Revue d'Économie Politique—

May–June, 1925—Les expériences monétaires récentes et la théorie quantitative : *Aftalion (Albert)*. Le retour à l'or en Grande-Bretagne d'après les banquiers anglais : *Baudin (Louis)*. Critique de "l'utilité finale" (*suite*) : *Turgeon (Charles)*. Les tendances sécessionnistes au Canada et leurs bases économiques : *Nestler-Tricoche (Georges)*.

July–August, 1925—Les conséquences de la hausse des prix au point de vue national, moral et intellectuel : *Gide (Charles)*. Les expériences monétaires récentes et la théorie du revenu : *Aftalion (Albert)*. L'indice monétaire et la théorie de la monnaie : *Divisia (François)*. Un nouvel aspect du conflit social. Les rapports de l'entrepreneur et du capitaliste : *Hoffherr (René)*. Critique de "l'utilité finale" (*suite*) : *Turgeon (Charles)*.

September–October, 1925—L'indice monétaire et la théorie de la monnaie (*suite*) : *Divisia (François)*. Les expériences monétaires récentes et la théorie psychologique de la monnaie : *Aftalion (Albert)*. Critique de "l'utilité finale" (*suite et fin*) : *Turgeon (Charles)*.

GERMANY—

Weltwirtschaftliches Archiv. *October, 1925*—Edgeworth und die neuere Wirtschaftstheorie : *Schumpeter (Dr. Joseph)*. Die methodischen Grundlagen der international-vergleichenden Finanzstatistik : *Colm (Dr. Gerhard)*. Die Bilanz der russischen Volkswirtschaft : *Leontief, Jr. (Wassily)*.

Zeitschrift für die gesamte Versicherungs-Wissenschaft—

October, 1925—Psychologie und Versicherungswesen : *Marbe (Dr. Karl)*. Das erhöhte Risiko der männlichen Stadtbevölkerung in der Lebensversicherung : *Paul (Dr. Otto)*.

January, 1926—Meilensteine auf dem Wege internationaler Versicherungs-Wissenschaft : *Manes (Prof. Alfred)*. Die internationale Sozialversicherung an der Vierteljahrhundertwende : *Hold (Dr. K.)*. Lebenserwartung und mittleres Alter der Lebenden : *Gumbel (Dr. E. J.)*. Das Problem einer obligatorischen Schiffspassagier-Unfallversicherung : *Bisschop (Dr. W. R.)*.

ITALY—

Annali di Economia. November, 1925—La fortuna di Malthus : Prato (Giuseppe). Il ritorno all'oro : Cabiati (Attilio). Sulle relazioni fra costo e quantità prodotta : Sraffa (Piero).

Giornale degli Economisti e Rivista di Statistica—

July, 1925—La politica di favore dei trasporti come forma di protezionismo : Canina (A. G.).

August, 1925—Infanticidio, abbandono d'infante e procurato aborto nella vita sociale, studiati sulle nostre statistiche della criminalità : Tagliacarne (Guglielmo).

September, 1925—Il mercato del lavoro della gente di mare e l'azione dei sindacati operai : Corbino (Epicarmo). F. Y. Edgeworth e l'economia matematica : Vecchio (Gustavo del).

October, 1925—La bilancia alimentare prebellica, bellica e postbellica di alcuni stati d'Europa : Zingali (Gaetano). Appendici allo studio "infanticidio, abbandono d'infante, ecc." : Tagliacarne (Guglielmo).

November, 1925—Contributo alla teoria dell'imposta sul reddito : Rediadis (Pericliis D.).

Giornale di Matematica Finanziaria. October, 1925—Su di un problema di annualità : Broggi (U.). Il calcolo dei momenti delle funzioni del rischio nell'ipotesi del Makeham : Vecchio (E. del).

Bollettino dell'Istituto Statistico-Economico, Trieste. July-August, 1925—Il traffico di Trieste ed Amburgo con la Cecoslovacchia dai 1923 ai primi quattro mesi del 1925 : Kurett (Dott. A.). Notiziario economico Jugoslavia, Turchia, Romania, Bulgaria.

La Riforma Sociale —

July-August, 1925—Protezionismo siderurgico e le industrie dei fili di ferro : Giretti (Edoardo). Teoria del punto critico monetario : Sella (Emanuele).

September-October, 1925—Miti liberistici o miti sindacali ? (Risposto a Prato) : Rosselli (Carlo). Carico minimo di mano d'opera e agricoltura : Masè-Dari (E.).

November-December, 1925—L'Economia del mare : Sella (Emanuele). Progressi e pericoli industriali : la seta artificiale : Giretti (Edoardo). Il bilancio esterno d'Italia nel 1924 : Curato (Giulio).

SWEDEN—

Ekonomisk Tidskrift. Häft 8-9, 1925—Pennyvärde och tullskydd : Brisman (Sven).

SWITZERLAND—

Journal de Statistique et Revue Economique Suisse. Fasc. II-III, 1925—Die Zollbelastung der schweizerischen Lebenshaltungskosten : Reichlin (Aug.). Die Lebensversicherung im Dienste der Eigenheimbestrebung : Jost (Walter).

INTERNATIONAL.—

International Labour Review—

August, 1925—Wage earners' participation in management in the United States. The Housing Problem in Soviet Russia. Unemployment in 1924 and the beginning of 1925.

September, 1925—Unemployment in Hungary: its causes and cure: *Vago (Josef)*. Trade union investment funds in Belgium, France, Germany and Spain: *Turmann (Mat)*. Vocational education in Soviet Russia: *Nikolsky (B. A.)*.

October, 1925—The compulsory adjustment of industrial disputes in Germany: *Sitzler (Dr. Fritz)*. International comparisons of real wages: *Klezi (Dr. Felix)*.

November, 1925—A systematic scheme for an employment policy: *Berger (Dr.)*. The commandite: co-operative work in the French printing industry: *Marauz (Charles)*. Labour conditions in China.

December, 1925—Recent development in industrial relations in the United States: *Feis (Herbert)*. Minimum wage legislation in Norway: *Voss (Fredrik)*.

Metron. Vol. IV, Nos. 3-4, I-VI, 1925—The theory of statistical relations, with special reference to cyclical series: *Pietra (G.)*. La fecondità delle aristocrazie: *Savorgnan (F.)*. A statistical study of India's population: *Shirras (G. Findlay)*. Vol. V, No. 1—On periods in economic life: *Westergaard (Harald)*. Methods of estimating the population of the United States: *Willcox (Walter F.)*. La mortalité causée par la guerre mondiale: *Hersch (L.)*.

World's Health—

September, 1925—The re-birth of Poland.

December, 1925—The excesses of birth-control: *Dublin (Louis I.)*.

LIST OF ADDITIONS TO THE LIBRARY.

Since the July, 1925, issue the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom and its several Divisions.

United Kingdom—

- Army Estimates, 1925-26. ii + 331 pp. London, 1925. Price 5s. 6d. net. (Dr. M. Epstein.)
- Memorandum relating to Army Estimates, 1925-26. 10 pp. 1925. Price 3d. net. Cmd. 2359. (*Id.*)
- Civil Service Estimates, 1925-26. 1 vol. 1925. Price 14s. net. (*Id.*)
- Coal Tables, 1924. 62 pp. 1925. Price 1s. net. (H.M. Stationery Office.)
- Registry of Friendly Societies. Registered provident societies in Great Britain. General summary, 1922-23. 3 pp. 1925. Price 4d. net. (*Id.*)
- Imperial Mineral Resources Bureau. Potash minerals, statistics, 1920-22-50 pp. 1925. Price 1s. 6d. net. (The Bureau.)
- Industrial Assurance Commissioner, Report, 1924. 116 pp. 1925. Price 2s. net. (Registry of Friendly Societies.)
- Industrial Courts Act, 1919. Report by a Court of Inquiry concerning the Coal Mining Industry Dispute. 1925. 28 pp. 1925. Price 6d. net. Cmd. 2478. (Purchased.)
- Ministry of Labour. Report for 1923-24. 280 pp. 1925. Price 4s. 6d. net. Cmd. 2481. (H.M. Stationery Office.)
- Navy Estimates, 1925-26. 305 pp. 1925. Price 9s. net. (Dr. Epstein.)
- Statement of the First Lord of the Admiralty. Explanatory of the Navy Estimates, 1925-26. 9 pp. 1925. Price 3d. net. Cmd. 2366. (*Id.*)
- Overseas Trade, Department of. Reports on conditions in Angola, June, 1925; Australia, June, 1925; Austria, August, 1925; British West Indies, June, 1925; China, June, 1925, with a report on trade of Dairen (Japanese leased territory in South Manchuria); Colombia, May, 1925; Egypt, June, 1925; Esthonia, March, 1925; France, July, 1925; Germany, with a report on the industries of the occupied territories; Greece, 1923-24; Hungary, March, 1925; British trade in India, 1924-25; Persia, April, 1925; Syria, 1925; London, 1925. (The Department.)
- Permanent Consultative Committee on Official Statistics. Guide to current official statistics, 1924. Vol. III. 249 pp. 1925. Price 1s. net. (The Committee.)
- Tramways and Light Railways (Street and Road) and Trackless Trolley Undertakings. Annual return of Capital and Traffic, 1923-24. 67 pp., fol. 1924. Price 1s. net. (Dr. Epstein.)

(a) United Kingdom and its several Divisions—*Contd.***United Kingdom—*Contd.****England and Wales—*

Ministry of Health. Annual report, 1924-25. xiv + 188 pp. 1925. Price 3s. 6d. net. Cmd. 2450. (The Ministry.)

Industrial Fatigue Research Board :—

Studies in Repetitive Work, with Special Reference to Rest-pauses. By S. Wyatt, assisted by J. A. Fraser. iv + 43 pp. 1925. Price 2s. 6d. net. (The Board.)

Experimental Investigation into Repetitive Work. By Isabel Burnett. 26 + iv pp. 1925. Price 2s. 6d. net. (*Id.*)

Channel Islands—

Census of Crops, Cattle, etc., 1923. Appendices. 7 pp. 1923. (Dr. Epstein.)

Isle of Man—

Accounts of Revenue and Expenditure, 1925. 6 pp. London, 1925. Price 4d. net. (Dr. Epstein.)

Scotland—

Leaving Certificate Examination. Examination papers, 1925. 80 pp. London, 1925. Price 1s. 9d. net. (Scottish Education Department.)

Leaving Certificate Examination, 1926. 19 pp. 1925. (*Id.*)

(b) India and Dominions.

India—

Census Tables. No. 41. Karenni States. 26 pp. Price 1s. 10d. No. 42. Southern Shan States. vii + 401 pp. 18s. No. 43. Northern Shan States. iii + 234 pp. 12s. Rangoon, 1925. (High Commissioner for India.)

District Gazetteers of United Provinces of Agra and Oudh. Vol. III. Muzaffarnagar District. 15 + lii pp. Price 14 annas. Vol. XII. Etah District. xliii pp. 10 annas. Allahabad, 1924. (High Commissioner for India.)

Tests of Indian Timbers in Structural Sizes. By L. N. Seaman. (Forest Research Institute, Dehra Dun (U.P.)) 16 pp. and figures. Calcutta, 1925. Price 10d. (Mr. J. E. Dodsworth.)

East India. Budget of the Governor-General in Council, 1924-25. 218 pp. London: H.M. Stationery Office, 1924. Price 6s. net. (Dr. Epstein.)

Bombay. Report on an Enquiry into Wages and Hours of Labour in the Cotton-mill Industry. iii + 128 pp. Bombay, 1925. Price 3s. (The Labour Office.)

Burma—

Gazetteer. Lower Chindwin District. Vol. B. No. 34. 54 pp. Rangoon, 1925. Price 2s. 6d. (High Commissioner for India.)

Australia—

Census, 1921. Vol. I. D.tailed tables. Part XIII. S. Australia. Population of local government areas; XIV. W. Australia. Population of local government areas; XVI. Territories; XVII. Occupations (including unemployment); XVIII. N.S.W. Dwellings in local government areas; XIX. Victoria. Dwellings in local government areas; XX. Queensland. Dwellings in local government areas; XXI. S. Australia. Dwellings in local government areas; XXIII. Tasmania. Dwellings in local government areas. Fol. vols. Price 2s. 6d. each vol. Melbourne, 1925. (The Bureau of Census and Statistics.)

Summary of Australian Population and Vital Statistics, 1924 and previous years. 241 pp., fol. 1925. (*Id.*)

Summary of Australian Production Statistics, 1913-14 to 1923-24. 178 pp., fol. 1925. (*Id.*)

(b) India and Dominions—Contd**Australia—Contd.***Tasmania—*

Report of Committee appointed to inquire into Tasmanian Disabilities under Federation. 45 pp. Hobart, 1925. (The Government Statistician, Hobart.)

Canada—

Chemicals and Allied Products, 1923. 49 pp. Ottawa, 1925. (Dominion Bureau of Statistics.)

Conference on Agricultural Statistics. Ottawa. January 29–31, 1924. (Transcript of shorthand notes.) 39 pp. 1925. (*Id.*)

Live Stock and Animal Products Statistics, 1924. 88 pp. 1925. Price 25 cents. (*Id.*)

British Columbia—

Agricultural statistics, 1923. 37 pp. Victoria, 1924. (Dr. Epstein.)

Annual report of Department of Railways, 1922–23. 31 pp. 1924. (*Id.*)

Report of the Forest Branch of Department of Lands, 1923. 63 pp. 1924. (*Id.*)

The Mineral Province of Canada: a short history of mining in the province, a synopsis of the mining laws in force, statistics of mineral production to date, and a brief summary of the progress of mining during 1923. 45 pp. 1924. (*Id.*)

Ceylon—

Supplement to Handbook, 1924. viii + 84 pp. Colombo, 1925. Price Rs. 1.50. (Statistics Office.)

Irish Free State—

Report of Committee on Economic Statistics. Appointed November 8, 1924, to advise the Minister for Industry and Commerce, Dublin. 11 pp., fol. Dublin, 1925. (Department of Industry.)

New Zealand—*Western Samoa—*

Report on trade, commerce and shipping of the territory, 1921. 24 pp., fol. Wellington, 1922. (Dr. Epstein.)

Union of South Africa—

Census, 1921. Part VI. Occupations and Industries (Europeans). 158 pp., 4to. Pretoria, 1925. Price 7s. 6d. (Office of Census and Statistics.)

Science Bulletins of the Department of Agriculture, Nos. 38, 39, 41, 42. 1925. (The Department.)

(c) Foreign Countries.**Argentina—**

El comercio exterior Argentino en el primer semestre de 1925 y su comparacion con el de igual periodo de 1924. 31 pp. Buenos Aires, 1925. (Dirección General de Estadística.)

Belgium—

Consommation de viande de boucherie, 1924. 17 pp. Bruxelles, 1925. (Ministère de l'Agriculture.)

Renseignements sur l'activité des associations d'intérêt agricole, 1921–23. 28 pp. 1925. (*Id.*)

Annuaire de la législation du travail, 1914 à 1919. Tome III. viii + 508 pp. 1925. (Ministère de l'Industrie.)

Historique et organisation des services. Liste des publications. 31 pp. 1925. (*Id.*)

Recensement général, 1920. Tome II. Population. vi + 519 pp. 1925. (Ministère de l'Intérieur.)

(c) Foreign Countries—*Contd.***Chile—**

Anuario estadístico, 1923. Vols. II, Beneficiencia, Medicina e Higiene. vii + 87 pp. Price \$3.30; III. Política y Administración. vii + 113 pp. \$4.20; IV. Justicia. Policía y Criminalidad. vii + 81 pp. \$4; V. Instrucción. vi + 82 pp. \$3 60. IX. Industria Manufacturera. 75 pp. \$3.40. XII. Comunicaciones. vi + 168 pp. \$7. Santiago, 1924. (Oficina Central de Estadística.)

China—

Remarks on revision of the table of prices in Shanghai, 1925. Explanations of the index-numbers of import and export prices in Shanghai, 1925. 110 pp. Shanghai, 1925. (Ministry of Finance.)

Shanghai—

The index-number of Customs import prices in Shanghai. 6 + 18 + 2 pp. 1925. (The Bureau of Markets.)

Index-numbers of supplementary import prices. 63 pp. 1925. (*Id.*)

Monthly Report on Prices and Price Indexes, October, 1925. Vol. I. No. I. 12 pp. 1925. (*Id.*)

The Shanghai wholesale price index-number. Edited by T. Sheng. 55 + 75 pp., 4to. 1925. (*Id.*)

Colombia—

Anuario estadístico. Comercio exterior, 1922. 198 pp. Bogotá, 1925. (Estadística General.)

— Degüello-Salinas Terrestres, 1918 a 1922. 105 pp. 1925. (*Id.*)

Denmark—

Elektricitetsværker, 1923–24. 75 pp. København, 1925. Price kr. 1·00 (Statistiske Departement.)

Emneliste over den danske statistiske Litteratur, 1924. 26 pp. 1925. Kr. 0·75. (*Id.*)

Folketaellingen, 1921. 143 + 190 pp. 4to. 1925. Kr. 4·00. (*Id.*)

Husholdningsregnskaber, 1922. 193 pp. 1925. Kr. 1·50. (*Id.*)

Husleje og Boligforhold, Nov., 1924. 127 pp. 1925. Kr. 1·00. (*Id.*)

De Kommunale Valg, 1925. 176 pp. 1925. Kr. 1·50. (*Id.*)

Produktionsstatistik, 1924. 55 pp. 1925. Kr. 0·50. (*Id.*)

Egypt—

Sudan Government. Director's annual report, 1921. 101 + 27 pp. Cairo, 1922. Price 1s.; 1922–23. 126 pp. Cairo, 1923. 1s.; 1923–24. 156 pp. London, 1924. 3s. (Dr. Epstein.)

Estonia—

Album statistique. Vol. I. Territoire et population. 33 maps. Tallinn, 1925. (Bureau Central de Statistique.)

Exercice des chemins de fer, 1923. Fonctionnement des postes, des télégraphes et des téléphones, 1923–24. 51 pp. 1925. (*Id.*)

Recensement, 1922. Tome III. Répartition de la population d'après les industries, services et classes sociales. 83 pp. 1925. (*Id.*)

France—

Recensement général, résultats statistiques, 1921. Tome II. Population présente. Résultats par département (Nord, Est, Sud-Est). 1 vol. Paris, 1925. (Statistique Générale de la France.)

Germany—

Der Auswärtige Handel, 1923–24. Heft II. Argentinien, Brasilien, Chile, Columbien, Paraguay, Peru, Uruguay, Venezuela. 192 pp.; VIII. Britische Besitzungen am und im Mittelländischen Meere, Spanien. Schweiz, Tschechoslowakei. 150 pp.; IX. Jugoslawien, Ungarn, Bulgarien, Albanien, Griechenland, Türkei, Helgoland, Badische Zollausschlüsse, Spitzbergen, usw., Schiffsbedarf für fremde Schiffe, Seekabel usw. 186 pp. Berlin, 1925. (Statistisches Reichsamt.)

(c) Foreign Countries—*Contd.***Germany—*Contd.***

Die deutsche Einkommensbesteuerung vor und nach dem Kriege. 88 pp. 1925. (Statistisches Reichsamt.)

Vorläufige Ergebnisse der Volkszählung, 1925, mit einem Anhang: Die abgetretenen Gebiete und das Abstimmungsgebiet an der Saar. 72 pp. 1925. (*Id.*)

Die Wahlen zum Reichstag, 1924. Heft II. Die Wahlen am 4 Mai, 1924. 80 pp.; IV. 7 Dec., 1924. 77 pp.; V. "Nationalen Minderheiten Deutschlands." 87 pp. Berlin, 1925. (*Id.*)

Baden—

Die endgültigen Ergebnisse der Volkszählung, 1925. 16 pp. Karlsruhe. 1925. (Statistisches Landesamt.)

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REVENUE OF THE UNITED KINGDOM.

*Net Produce in Quarters of 1925, and in Financial Years ended
March 31, 1924-25, 1923-24, 1922-23, 1921-22.*

(000's omitted.)

QUARTERS, ended	March 31, 1925.	June 30, 1925.	Sept. 30, 1925.	Dec. 31, 1925.	Total for calendar year 1925.
	£	£	£	£	£
Customs	23,871,	24,181,	25,806,	27,910,	101,858,
Excise	32,876,	29,527,	32,378,	40,368,	135,149,
Stamps and Estate Duties ..	21,580	19,010,	20,190,	21,470,	82,250,
Land Tax, House Duty and Mineral Rights Duty	760,	110,	30,	30,	960,
Postal Service	9,500,	7,350,	8,000,	9,750,	35,500,
Telegraph Service	1,300,	1,300,	1,300,	1,450,	5,350,
Telephone Service	3,600,	3,800,	3,950,	4,100,	15,450,
	93,487,	86,238,	92,611,	105,078,	377,417,
Property and Income Tax, including Super-tax	172,831,	58,818,	62,752,	35,087,	329,488,
	266,318,	145,056,	155,363,	140,165,	706,935,
Excess Profits Duties	700,	—	—	—	700,
Corporation Profits Tax	5,330,	3,320,	2,720,	2,120,	13,490,
Motor Vehicle Duties	10,949,	2,833,	2,005,	1,320,	17,107,
Crown Lands	180,	220,	240,	310,	930,
Interest on Sundry Loans ..	2,086,	3,792,	4,616,	2,418,	12,912,
Miscellaneous— Ordinary receipts	5,420,	2,386,	3,086,	3,080,	18,952,
Special receipts	4,368,	11,580,	6,884,	6,351,	28,983,
Totals	295,331,	169,187,	174,747,	155,744,	795,009,

YEARS, ended March 31,	1924-25.	1923-24.	1924-25 (compared with 1923-24).		Corresponding years.	
			Increase.	Decrease.	1922-23.	1921-22.
	£	£	£	£	£	£
Customs	99,314,	119,958,	—	20,614,	123,013,	130,052,
Excise	135,128,	147,970,	—	12,842,	157,275,	191,291,
Stamps and Estate Duties ..	82,300,	79,370,	2,930,	—	79,093,	71,820,
Land Tax, House Duty and Mineral Rights Duty	1,450,	2,760,	—	1,310,	2,980,	2,500,
Postal Service	34,850,	32,840,	2,010,	—	34,150,	10,000,
Telegraph Service	5,000,	5,570,	30,	—	5,500,	5,900,
Telephone Service	15,000,	14,300,	610,	—	13,550,	10,500,
	373,072,	402,858,	5,580,	31,766,	415,591,	455,162,
Property and Income Tax (including Super-tax)	336,516,	320,971,	6,545,	—	379,045,	398,887,
	710,188,	723,829,	12,125,	34,766,	794,636,	854,049,
Excess Profits Duties, &c. ..	700,	—	700,	—	2,004,	30,452,
Corporation Profits Tax	18,100,	23,340,	—	5,240,	18,977,	17,516,
Motor Vehicle Duties	16,164,	14,691,	1,473,	—	12,321,	11,096,
Crown Lands	960,	920,	40,	—	900,	820,
Interest on Sundry Loans ..	11,941,	12,607,	—	666,	10,016,	13,807,
Miscellaneous— Ordinary receipts	14,419,	15,981,	—	1,561,	24,141,	26,333,
Special receipts	26,963,	36,801,	—	9,838,	51,017,	170,806,
Totals	799,435,	837,169,	14,338,	52,071,	914,012,	1,124,779,
			NET DEC. £37,733,			

Values (c.i.f.) of Imports into the United Kingdom for the years 1923-24-25.*

(From the Monthly Trade Returns, December, 1925.)

	Year ended December 31,			Increase (+) or Decrease (-) In 1925 as compared with 1924.	Increase (+) or Decrease (-) In 1925 as compared with 1923.
	1923.	1924.	1925.		
I. FOOD, DRINK AND TOBACCO—					
A. Grain and flour	96,645,199	120,647,088	111,878,199	- 8,768,889	+ 15,233,000
B. Feeding-stuffs for animals	5,794,098	8,007,770	9,067,879	+ 160,109	+ 3,273,781
C. Meat	111,377,662	106,572,261	122,464,017	+ 15,892,358	+ 11,086,955
D. Animals, living, for food	14,023,801	22,049,339	17,575,689	- 1,173,680	+ 3,546,888
E. Other food and drink, non- durable	149,232,204	165,775,322	175,350,901	+ 9,571,679	+ 26,117,797
F. Other food and drink, durable	115,415,383	120,849,778	118,170,759	- 11,679,019	+ 2,764,376
G. Tobacco	16,371,384	17,826,340	17,000,936	- 229,413	+ 725,552
Total, Class I	508,884,731	571,127,040	571,614,080	+ 185,140	+ 62,718,349
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED—					
A. Coal	19,280	15,837	20,272	+ 1,435	+ 1,003
B. Other non-metallic mining and quarry products and the like	5,638,314	5,739,616	5,746,290	+ 6,671	+ 107,976
C. Iron ore and scrap	7,754,751	8,520,121	5,110,144	- 3,409,980	- 2,644,610
D. Non-ferrous metalliferous ores and scrap	12,410,594	15,177,800	16,497,851	+ 1,320,051	+ 1,087,257
E. Wood and timber	47,716,000	51,070,681	46,511,073	- 1,559,611	- 1,234,927
F. Raw cotton and cotton waste	93,414,265	121,595,972	125,581,106	+ 3,985,434	+ 32,137,141
G. Wool, raw, and waste, and woollen rags	50,302,815	71,735,399	76,032,520	+ 1,297,127	+ 25,720,711
H. Silk, raw, knots and noils	1,609,134	1,807,597	1,617,668	- 119,929	+ 48,534
I. Other textile materials	10,235,327	15,363,772	18,153,480	+ 2,789,558	+ 7,918,003
J. Oil seeds, nuts, oils, fats, resins and gums	44,480,013	51,940,611	55,514,625	+ 3,574,011	+ 11,034,582
K. Hides and skins, undressed	16,838,604	21,260,188	21,807,701	+ 547,216	+ 1,919,100
L. Paper-making materials	11,643,876	11,563,477	11,109,452	- 454,025	- 131,424
M. Rubber	12,257,209	9,628,308	20,713,705	+ 20,115,397	+ 17,486,490
N. Miscellaneous raw materials and articles mainly un- manufactured	10,661,589	11,599,726	11,722,620	+ 122,904	+ 1,061,041
Total, Class II.	324,961,793	400,010,414	425,208,676	+ 25,189,262	+ 100,216,883
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—					
A. Coke and manufactured fuel	20,279	5,930	9,926	+ 3,996	- 10,353
B. Earthenware, glass, abra- sives, &c.	7,560,319	8,704,761	10,094,635	+ 1,389,871	+ 2,534,316
C. Iron and steel and manu- factures thereof	13,772,873	22,387,121	23,998,973	+ 1,611,449	+ 10,226,100
D. Non-ferrous metals and manufactures thereof	25,629,145	32,717,304	38,111,960	+ 5,421,566	+ 12,512,515
E. Cutlery, hardware, imple- ments, and instruments	7,060,614	7,633,965	9,666,181	+ 2,032,519	+ 2,585,870
F. Electrical goods and apparatus	2,394,721	3,371,922	4,270,863	+ 898,941	+ 1,776,142
G. Machinery	9,331,417	10,516,082	11,890,787	+ 1,311,705	+ 2,559,310
H. Manufactures of wood and timber	4,584,588	5,370,727	6,229,192	+ 858,465	+ 1,644,601
I. Cotton yarns and manufactu- res	8,717,950	9,319,697	9,830,811	+ 511,144	+ 1,112,891
J. Woolen and worsted yarns and manufactures	11,781,081	14,893,841	15,125,721	+ 231,880	+ 3,344,040
K. Silk and silk manufactures	22,897,843	25,207,128	22,583,778	- 2,623,650	- 311,065
L. Manufactures of other textile materials	14,197,868	16,892,238	18,185,478	+ 1,293,240	+ 3,987,010
M. Apparel	16,587,114	19,144,199	21,146,619	+ 2,002,420	+ 4,579,505
N. Chemicals, drugs, dyes and colours	13,421,403	14,617,175	14,402,140	- 215,035	+ 980,737
O. Oils, fats, and resins, manu- factured	31,460,652	39,169,583	36,634,923	- 2,531,560	+ 2,177,371

* The value of the Imports represents the cost, insurance, and freight; or, when goods are consigned for sale, the latest sale value of such goods.

Values (c.i.f.) of Imports for the years 1923-24-25—Contd.

(From the Monthly Trade Returns, December, 1925.)

	Year ended December 31,			Increase (+) or Decrease (—) in 1925 as compared with 1924.	Increase (+) or Decrease (—) in 1925 as compared with 1923.
	1923.	1924.	1925.		
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED— <i>Contd.</i>					
P. Leather and manufactures thereof	£ 11,904,402	£ 14,394,374	£ 15,077,957	+ 683,583	+ 3,173,555
Q. Paper and cardboard	13,592,893	14,424,018	15,085,314	+ 661,296	+ 1,492,121
R. Vehicles (including locomotives, ships and aircraft)	7,505,678	9,140,253	12,307,820	+ 3,167,567	+ 4,802,112
S. Rubber manufactures	5,008,707	4,958,148	6,327,615	+ 1,369,467	+ 1,318,908
T. Miscellaneous articles, wholly or mainly manufactured	26,548,987	26,874,093	28,826,323	+ 1,951,330	+ 2,277,356
Total, Class III	236,978,844	290,773,852	319,840,449	+ 20,066,597	+ 62,861,605
IV. ANIMALS, NOT FOR FOOD	1,543,418	2,527,837	2,302,680	— 225,148	+ 759,271
V. PARCEL POST, NON-DUTIABLE ARTICLES	3,877,428	3,990,101	3,893,273	— 96,828	+ 15,815
Total	1,096,226,214	1,277,439,144	1,322,858,167	+ 45,419,023	+ 226,631,953

Values (f.o.b.) of Exports of British and Irish Produce and Manufactures for the years 1923-24-25.*

(From the Monthly Trade Returns, December, 1925.)

	Year ended December 31,			Increase (+) or Decrease (—) in 1925 as compared with 1924.	Increase (+) or Decrease (—) in 1925 as compared with 1923.
	1923.	1924.	1925.		
I. FOOD, DRINK, AND TOBACCO—					
A. Grain and flour	£ 4,741,320	£ 7,438,991	£ 9,049,982	+ 1,610,991	+ 4,308,662
B. Feeding-stuffs for animals	1,817,255	3,079,347	3,079,808	+ 161	+ 1,262,553
C. Meat	1,437,564	1,630,097	1,726,528	+ 96,431	+ 288,961
D. Animals, living, for food	177,035	260,121	164,540	— 95,581	— 12,495
E. and F. Other food and drink	23,299,394	38,004,956	33,920,302	— 4,084,654	+ 1,620,908
G. Tobacco	6,870,981	6,511,008	7,055,928	+ 544,920	+ 184,947
Total, Class I	44,343,540	56,957,520	51,997,088	— 1,960,432	+ 10,653,539
II. RAW MATERIALS AND ARTICLES MAINLY UNMANUFACTURED					
A. Coal	99,817,237	72,079,547	50,177,211	— 21,902,336	— 49,370,026
B. Other non-metallic mining and quarry products and the like	1,807,080	2,114,092	1,951,571	— 162,521	+ 111,491
C. Iron ore and scrap	542,923	421,553	117,314	+ 25,761	— 95,014
D. Non-ferrous metalliferous ores and scrap	2,109,327	1,374,065	1,327,268	— 46,797	— 782,059
E. Wood and timber	464,636	641,790	756,231	+ 114,441	+ 291,595
F. Raw cotton and cotton waste	1,651,468	1,855,450	1,766,222	— 89,228	+ 114,751
G. Wool, raw and waste, and woollen rags	9,749,283	12,437,106	11,495,511	— 941,595	+ 1,746,228
H. Silk, raw, knits and noils	115,822	128,004	64,397	— 63,607	— 51,425
I. Other textile materials	538,082	403,601	549,321	+ 145,720	+ 11,239
J. Oil seeds, nuts, oils, fats, resins, and gums	5,619,500	6,917,502	7,025,243	+ 107,741	+ 1,405,743
K. Hides and skins, undressed	2,349,651	2,501,366	2,911,328	+ 409,962	+ 561,677
L. Paper-making materials	1,593,168	1,877,591	1,865,166	— 12,425	+ 301,998
M. Rubber	122,479	117,719	287,982	+ 170,263	+ 165,503
N. Miscellaneous raw materials and articles mainly unmanufactured	4,335,186	3,612,330	3,445,890	— 166,440	— 889,287
Total, Class II	130,815,847	106,481,725	84,370,064	— 22,111,061	— 46,445,183

* The value of the Exports represents the cost and the charges of delivering the goods on board the ship, and is known as the "free on board" value.

Values (f.o.b.) of Exports for the years 1923-24-25—Contd.

(From the Monthly Trade Returns, December, 1925.)

	Year ended December 31.			Increase (+) or Decrease (-) in 1925 as compared with 1924.	Increase (+) or Decrease (-) in 1925 as compared with 1923.
	1923.	1924.	1925.		
	£	£	£	£	£
III. ARTICLES WHOLLY OR MAINLY MANUFACTURED—					
A. Coke and manufactured fuel ..	10,099,351	6,231,108	3,836,026	- 2,394,482	- 6,262,725
B. Earthenware, glass, abrasives, &c.	12,318,533	12,863,540	12,078,748	+ 115,208	+ 660,213
C. Iron and steel and manufactures thereof	76,155,978	74,534,120	68,162,243	- 6,371,886	- 7,993,735
D. Non-ferrous metals and manufactures thereof	14,401,309	15,658,997	16,811,174	+ 1,182,777	+ 2,316,805
E. Cutlery, hardware, implements and instruments ..	7,410,473	8,191,328	9,085,351	+ 591,023	+ 1,074,878
F. Electrical goods and apparatus ..	10,226,377	10,680,953	11,788,638	+ 907,715	+ 1,362,321
G. Machinery	44,516,164	44,782,960	49,069,279	+ 4,286,319	+ 1,553,115
H. Manufactures of wood and timber	1,861,143	2,288,639	2,298,200	+ 9,561	+ 433,757
I. Cotton yarns and manufactures	177,303,623	199,162,166	199,305,297	+ 143,131	+ 21,911,674
J. Woollen and worsted yarns and manufactures	62,626,116	67,797,314	58,957,053	- 8,840,261	- 3,669,392
K. Silk and silk manufactures	2,042,661	2,186,580	1,811,734	- 341,846	- 200,930
L. Manufactures of other textile materials	23,717,121	27,531,630	27,888,045	+ 356,406	+ 4,170,921
M. Apparel	26,434,631	30,048,576	28,002,585	- 1,113,991	+ 2,167,954
N. Chemicals, drugs, dyes and colours	25,086,791	25,478,373	23,576,571	- 1,901,802	- 2,110,220
O. Oils, fats and resins, manufactured	6,992,118	8,020,766	10,225,633	+ 1,304,867	+ 3,233,515
P. Leather and manufactures thereof	5,766,247	7,107,104	7,048,221	- 18,883	+ 1,321,974
Q. Paper and cardboard	8,762,993	9,220,550	9,832,025	+ 612,475	+ 1,069,027
R. Vehicles (including locomotives, ships and aircraft)	27,748,723	26,921,526	32,751,348	+ 5,829,822	+ 5,005,625
S. Rubber manufactures	5,280,375	6,077,411	7,612,682	+ 1,535,271	+ 2,332,307
T. Miscellaneous articles, wholly or mainly manufactured ..	30,412,250	32,862,372	34,131,423	+ 1,269,051	+ 4,022,173
Total, Class III	579,949,674	618,855,191	616,278,036	- 2,576,555	+ 36,329,202
IV. ANIMALS, NOT FOR FOOD	1,400,177	2,209,325	2,207,418	- 1,877	+ 807,271
V. PARCEL POST	10,718,524	16,372,776	15,142,271	- 1,230,502	+ 4,393,750
Total	767,257,771	800,966,837	773,086,410	- 27,880,427	+ 5,828,430

BANK OF ENGLAND.

Pursuant to the Act 7th and 8th Victoria, cap. 32 (1844),

(000 omitted)

1	2	3	4	5	6	7
ISSUE DEPARTMENT.					COLLATERAL COLUMNS.	
Liabilities.	DATES. (Wednesdays.)	Assets.			Notes in Hands of Public.	Minimum Rates of Discount at Bank of England.
Notes Issued.		Government Debt.	Other Securities.	(Gold Coin and Bullion.	(Col. 1 minus col. 6)	
£	1925.	£	£	£	£	Per cent.
146,488	Jan. 7.....	11,015	8,735	126,738	127,503	4
146,493	" 14.....	11,015	8,735	126,743	126,133	
146,494	" 21.....	11,015	8,735	126,744	124,843	
146,496	" 28.....	11,015	8,735	126,746	124,450	
146,497	Feb. 4.....	11,015	8,735	126,747	125,165	5
146,498	" 11.....	11,015	8,735	126,748	124,848	
146,504	" 18.....	11,015	8,735	126,754	124,232	
146,511	" 25.....	11,015	8,735	126,761	124,803	
146,530	Mar. 4.....	11,015	8,735	126,780	124,827	5
146,537	" 11.....	11,015	8,735	126,787	124,200	
146,537	" 18.....	11,015	8,735	126,787	124,074	
146,541	" 25.....	11,015	8,735	126,791	124,378	
146,644	Apr. 1.....	11,015	8,735	126,894	121,310	
146,648	" 8.....	11,015	8,735	126,898	122,485	
146,653	" 15.....	11,015	8,735	126,903	121,363	
146,656	" 22.....	11,015	8,735	126,906	120,279	
173,606	" 29.....	11,015	8,735	153,906	148,387	
171,581	May 6.....	11,015	8,735	152,856	148,288	
173,829	" 13.....	11,015	8,735	151,831	147,606	
174,629	" 20.....	11,015	8,735	154,079	147,241	
174,407	" 27.....	11,015	8,735	154,879	148,183	
174,080	June 3.....	11,015	8,735	151,657	148,831	
175,554	" 10.....	11,015	8,735	155,230	148,026	
175,103	" 17.....	11,015	8,735	155,804	145,972	
175,508	" 24.....	11,015	8,735	155,353	145,270	
175,506	July 1.....	11,015	8,735	155,756	146,020	
176,797	" 8.....	11,015	8,735	157,017	145,206	
170,470	" 15.....	11,015	8,735	150,726	143,449	
181,194	" 22.....	11,015	8,735	161,441	143,392	11
182,316	" 29.....	11,015	8,735	162,466	141,741	
182,405	Aug. 5.....	11,015	8,735	162,655	146,320	
182,184	" 12.....	11,015	8,735	162,431	145,453	
181,952	" 19.....	11,015	8,735	162,202	141,181	11
181,117	" 26.....	11,015	8,735	161,397	144,267	
180,468	Sept. 2.....	11,015	8,735	160,718	144,079	
179,811	" 9.....	11,015	8,735	159,561	144,196	
178,956	" 16.....	11,015	8,735	159,236	143,527	
178,605	" 23.....	11,015	8,735	158,855	142,911	
178,391	" 30.....	11,015	8,735	158,641	144,775	
175,880	Oct. 7.....	11,015	8,735	156,110	143,961	1
173,808	" 14.....	11,015	8,735	154,058	143,131	
170,640	" 21.....	11,015	8,735	150,890	142,541	
168,191	" 28.....	11,015	8,735	148,441	142,079	
166,980	Nov. 4.....	11,015	8,735	147,230	141,112	
166,005	" 11.....	11,015	8,735	146,255	141,510	
166,620	" 18.....	11,015	8,735	145,870	142,203	
164,636	" 25.....	11,015	8,735	144,486	141,953	
163,618	Dec. 2.....	11,015	8,735	143,868	141,283	
162,926	" 9.....	11,015	8,735	143,176	141,319	
162,696	" 16.....	11,015	8,735	142,916	141,153	
162,553	" 23.....	11,015	8,735	142,803	141,278	
162,514	" 30.....	11,015	8,735	142,704	141,731	

—WEEKLY RETURN.

for Wednesday in each Week, during the Year 1925.

(000 omitted.)

8	9	10	11	12	13	14	15	16	17	18	
BANKING DEPARTMENT.											
Liabilities.						Assets.					Totals of Liabi- lities and Assets.
Capital and Rest.		Deposits.		Seven Day and other Bills.	DATE. (Wednes- days.)	Securities.		Reserve.			
Capital.	Rest.	Public.	Private.			Government.	Other.	Notes.	Gold and Silver Coin.		
£	£	£	£	£	1925.	£	£	£	£	£	
14,553	3,420	12,912	117,170	8	Jan. 7....	51,665	75,656	18,925	1,826	148,072	
14,553	3,468	11,059	117,805	7	" 11....	50,980	74,386	20,350	1,827	147,552	
14,553	3,483	22,922	107,007	6	" 21....	19,213	75,280	21,651	1,827	147,971	
14,553	3,511	22,550	107,272	6	" 28....	50,038	73,991	22,030	1,824	147,892	
14,553	3,531	17,019	134,013	1	Feb. 1....	67,504	73,688	21,032	1,826	164,050	
14,553	3,552	9,509	115,081	1	" 11....	45,820	73,160	21,650	1,829	142,759	
14,553	3,575	13,705	111,244	6	" 18....	13,912	75,014	22,272	1,825	143,083	
14,553	3,610	10,744	105,543	11	" 25....	11,027	71,400	21,708	1,820	139,861	
14,553	3,699	9,825	119,105	8	Mar. 4....	43,607	80,049	21,703	1,831	147,190	
14,553	3,711	13,087	110,160	5	" 11....	40,087	78,100	22,336	1,823	142,416	
14,553	3,714	13,753	108,508	8	" 18....	39,862	76,349	22,163	1,832	140,536	
14,553	3,722	15,488	105,017	10	" 25....	38,798	76,900	22,163	1,820	139,690	
14,553	3,720	17,762	118,546	10	Apr. 1....	42,440	84,982	25,334	1,826	154,591	
14,553	3,155	13,126	109,505	8	" 8....	39,878	74,496	24,163	1,810	140,347	
14,553	3,143	11,780	110,333	7	" 15....	39,292	76,410	25,200	1,818	142,816	
14,553	3,160	17,058	105,770	1	" 22....	36,812	75,529	26,377	1,827	140,545	
14,553	3,115	17,018	105,481	5	" 29....	36,852	76,245	25,260	1,836	140,202	
14,553	3,106	11,021	107,717	4	May 6....	37,610	72,735	21,319	1,827	136,491	
14,553	3,253	17,426	102,159	4	" 13....	33,302	78,332	23,975	1,786	137,395	
14,553	3,267	15,748	102,232	5	" 20....	35,351	72,027	26,588	1,820	135,795	
14,553	3,284	15,779	106,716	1	" 27....	37,037	75,042	26,446	1,811	140,336	
14,553	3,227	11,604	114,110	4	June 3....	12,007	73,110	25,578	1,816	143,198	
14,553	3,234	8,954	112,428	1	" 10....	38,877	70,501	26,051	1,841	139,173	
14,553	3,273	13,368	109,626	5	" 17....	38,502	70,049	26,681	1,793	140,845	
14,553	3,317	13,559	118,254	5	" 31....	39,032	70,023	26,832	1,831	140,718	
14,553	3,410	17,659	143,951	5	July 1....	10,577	96,278	28,877	1,866	173,578	
14,553	3,450	17,250	118,053	3	" 8....	42,517	71,002	31,502	1,811	147,015	
14,553	3,478	12,595	115,229	5	" 15....	36,007	71,081	36,328	1,811	145,800	
14,553	3,492	15,571	110,691	1	" 22....	34,960	69,762	37,802	1,790	141,114	
14,553	3,520	20,090	103,264	1	" 29....	33,600	69,171	37,166	1,791	140,031	
14,553	3,577	17,037	110,198	1	Aug. 5....	33,599	68,210	36,085	1,815	139,660	
14,553	3,557	15,733	110,730	5	" 12....	31,219	71,000	36,931	1,822	141,478	
14,553	3,584	16,535	110,236	3	" 19....	33,080	71,323	37,798	1,831	144,911	
14,553	3,610	21,813	104,218	5	" 26....	35,414	70,114	36,850	1,827	141,205	
14,553	3,715	12,665	116,781	3	Sept. 2....	39,617	70,767	35,400	1,813	147,717	
14,553	3,715	13,232	115,771	3	" 9....	37,611	72,431	35,110	1,816	147,274	
14,553	3,690	17,450	111,040	3	" 16....	38,614	71,445	35,458	1,828	146,715	
14,553	3,718	17,047	111,474	5	" 23....	36,634	75,304	36,664	1,806	149,797	
14,553	3,732	27,110	102,391	5	" 30....	36,773	75,576	38,017	1,825	147,721	
14,553	3,072	9,517	109,508	6	Oct. 7....	33,742	66,238	31,809	1,807	136,686	
14,553	3,085	8,155	103,413	4	" 14....	28,822	68,228	30,675	1,785	129,510	
14,553	3,083	9,018	109,182	1	" 21....	32,379	74,111	28,100	1,860	136,440	
14,553	3,104	11,106	102,615	3	" 28....	30,178	74,749	25,212	1,842	137,382	
14,553	3,142	11,213	105,801	3	Nov. 1....	35,210	75,148	25,538	1,816	137,712	
14,553	3,186	13,109	109,199	7	" 11....	39,103	74,422	21,486	1,803	140,114	
14,553	3,198	15,118	106,631	7	" 18....	40,248	73,062	21,417	1,810	139,537	
14,553	3,201	11,271	111,441	4	" 25....	41,598	77,347	22,063	1,818	143,470	
14,553	3,253	8,525	120,021	4	Dec. 2....	62,138	71,605	20,335	1,791	156,559	
14,553	3,323	8,787	128,225	5	" 9....	51,367	71,081	19,607	1,832	146,887	
14,553	3,325	10,718	118,295	2	" 16....	18,368	78,127	18,543	1,855	146,893	
14,553	3,353	17,652	108,300	2	" 23....	15,423	70,790	16,825	1,818	143,864	
14,553	3,345	8,362	160,082	2	" 30....	61,088	103,281	17,783	1,792	186,614	

FOREIGN EXCHANGES.—*Quotations as under, LONDON on Paris, Berlin and Calcutta; New York and Hong Kong on LONDON, 1925.*

DATE. (Wednesdays.)	1	2	3	4	5	6 7 Price per Ounce	
	London on Paris. Cables (middle rate).	London on Berlin. Cables (middle rate).	London on Calcutta. (middle rate) (Thurs- days.)	New York on London. Cables (closing rate).	Hong Kong on London. T.T.	Gold Bars (Fine).	Silver Stan- dard Bars (cash).
	<i>£ s. d.</i>	<i>Reich- marks.</i>	<i>£ s. d.</i>	<i>\$ c.</i>	<i>£ s. d.</i>	<i>£ s. d.</i>	<i>£ s. d.</i>
1925.							
Jan. 7	95.55	20.00½	1.6 ¹ ₁₀	4.76	3.1 ³ ₁	87.5	2.7 ¹ ₁₀
„ 21	88.68½	20.05½	1.5 ¹ ₁₀	4.78	3.1 ¹ ₁	87.3	2.8 ¹ ₁₀
Feb. 4	88.51½	20.11½	1.5 ¹ ₁₀	4.79	2.3 ⁷ ₈	87.1	2.8 ¹ ₁₀
„ 18	89.93½	20.02½	1.6	4.75	2.3 ⁷ ₈	86.11	2.8 ¹ ₁₀
Mar. 4	93.96½	20.01½	1.6	4.76	2.3 ⁵ ₈	86.9	2.8 ³ ₁₀
„ 18	94.54½	20.07½	1.5 ¹ ₁₀	4.78	2.3 ¹ ₁	86.8	2.8 ¹ ₁₀
Apl. 1	90.96	20.07½	1.5 ¹ ₁₀	4.77	2.3 ¹ ₈	86.6	2.8 ¹ ₁₀
„ 15	93.40	20.10½	1.5 ² ₁₀	4.78	2.3	86.7	2.7 ¹ ₁₀
„ 29	92.65	20.34½	1.5 ² ₁₀	4.84	2.2 ⁷ ₈	84.11½	2.7 ¹ ₁₀
May 13	93.29½	20.38	1.6	4.85	2.3	84.11½	2.7 ¹ ₁₀
„ 27	97.15	20.43½	1.5 ¹ ₁₀	4.86	2.2 ⁷ ₈	84.11½	2.7 ¹ ₁₀
June 10	98.95	20.42	1.6 ³ ₁₀	4.86	2.3½	84.11½	2.7 ¹ ₁₀
„ 24	104.32½	20.42	1.6 ¹ ₁₀	4.86	2.3 ⁷ ₈	84.11½	2.8 ¹ ₁₀
July 8	101.87½	20.42	1.6 ¹ ₁₀	4.86	2.3 ¹ ₈	84.10½	2.8 ¹ ₁₀
„ 22	102.94½	20.42	1.6 ¹ ₁₀	4.86	2.3 ⁷ ₈	84.10½	2.8 ¹ ₁₀
Aug. 5	103.10	20.40	1.6 ¹ ₁₀	4.85	2.3 ⁷ ₈	84.11½	2.8
„ 19	103.42½	20.40½	1.6 ¹ ₁₀	4.85	2.4 ¹ ₄	84.11½	2.8½
Sept. 2	103.40	20.38½	1.6 ³ ₁₀	4.85	2.4½	84.10½	2.8 ⁷ ₁₀
„ 16	102.71	20.37	1.6 ³ ₁₀	4.84	2.4 ⁷ ₈	84.11½	2.8 ⁷ ₁₀
„ 30	102.37½	20.34½	1.6 ¹ ₁₀	4.84	2.4½	84.11½	2.8 ¹ ₁₀
Oct. 14	107.22½	20.33½	1.6 ³ ₁₀	4.84	2.5½	84.11½	2.8 ¹ ₁₀
„ 28	116.25½	20.36½	1.6 ¹ ₁₀	4.84	2.5	84.10½	2.9 ¹ ₁₀
Nov. 11	121.80	20.35½	1.6 ³ ₁₀	4.84	2.4½	84.11½	2.8
„ 25	129.58½	20.34½	1.6 ³ ₁₀	4.84	2.4½	84.11½	2.8½
Dec. 9	128.94½	20.36½	1.6 ³ ₁₀	4.84	2.4½	84.11½	2.8½
„ 23	132.19½	20.36½	1.6 ¹ ₁₀	4.85	2.4½	84.11	2.7½

JOURNAL OF THE ROYAL STATISTICAL SOCIETY.

MARCH, 1926.

THE PRODUCTIVITY OF BRITISH AND DANISH FARMING.

By R. J. THOMPSON, (C.B., O.B.E.

[Read before the Royal Statistical Society, January 19, 1926, the President,
Mr. G. UDNY YULE, C.B.E., F.R.S., in the Chair.]

A GOOD deal of attention has been directed lately to the relative productivity of British farming as compared with that of some Continental countries, more particularly Denmark, and it might well be supposed that nothing new could be said on the subject. The conclusions reached are, however, by no means uniform. On the one hand, it is suggested that the output from the soil of Great Britain is less than that of, say, Germany or Denmark, and that therefore it should be possible by the adoption of different or improved methods to increase the home production of food-stuffs. On the other hand, it is contended that the practical farmer, tied as he must necessarily be by costs of production and prices, is producing as much as is economically possible under existing conditions.

The divergence in views which exist^{or} seems largely to arise from the fact that agricultural productivity can be looked at from different points of view. Attention may be focussed on the productivity of the soil, expressed in terms of the gross output of crops and live stock, and emphasis laid on the claim^{ment} from a national point of view it is desirable to secure the maximum^{are} production of food-stuffs from the land and the employment of the greatest number of persons that is economically possible. From a suitable angle, the productivity of the industry is solely represented by the output^{trms} obtained relatively

to the capital and labour employed, and it is contended that the object of agriculture is to produce such quantity of food-stuffs as will give the farmer the maximum return on the capital invested, and that it would not be in the national interest to attempt to produce food at an undue cost either in money or labour.

The need for taking account of both points of view makes any complete comparison between the agricultural productivity of different countries almost impossible, because while it is easy, by means of the available statistics, to compare the relative production of crops or the number of live stock, it is impracticable to make accurate comparisons of the relative profitability of the industry in any two countries. It is, of course, for this reason that so much prominence has been given to that aspect of the question which is based on actual output. The difficulties need not, however, prevent us from recognizing that international comparisons in agriculture, as in other industries, must not be based on output, but must take account also of the factors entering into costs of production and of general economic conditions. Mr. R. B. Forrester, in some recent comments on this question, remarks that "output, irrespective of the costs of the factors of production involved, is not a standard which would be accepted in any other industry as a basis of contrast since it is obvious that the difference may have been due to specially heavy applications of labour and capital to the land factor, leaving out of account differences in natural resources."* The lack of information on points necessary to enable any such general and complete comparison to be undertaken almost closes the door, but in view of the attention that has been directed to Danish agriculture in comparison with our own, usually to the disadvantage of Great Britain, it may not be altogether unprofitable to attempt to bring together such facts bearing on the question as can be obtained, and endeavour to examine them impartially from a statistical point of view.

The points which need to be considered are: (1) the yield per acre of crops; (2) the live stock per 100 acres; (3) the gross production or output per 100 acres; (4) the proportion of arable land; (5) the number of persons employed; (6) the costs of production expressed in terms of wages and labour costs, rent or interest on capital; and (7) prices. In regard to the first five points some moderate degree of accuracy is possible, and in regard to the remainder the evidence, such as it is, must of necessity be suggestive rather than conclusive.

* "International Comparison of Productive Efficiency in Industry and Agriculture," by R. B. Forrester.

of Productive Efficiency in Industry and Agriculture, *Economica*, January, 1923.)

Yield of crops per acre.

The yield per acre of the leading crops is a measure of relative productivity, and is perhaps chiefly of value as showing similarity or otherwise in agricultural practice and in the available soil. Figures are given below for England, Wales, Scotland, Great Britain, and Denmark.

Average yield per acre of certain crops for the five years 1920-4 in the undermentioned countries.

	England.	Wales.	Scotland	Great Britain	Denmark.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Wheat	17.6	14.5	21.0	17.6	22.9
Barley	14.7	12.3	17.3	14.9	18.7
Oats	13.6	9.8	14.2	13.6	14.3
	Tons.	Tons.	Tons.	Tons.	Tons.
Potatoes	6.1	5.0	6.8	6.2	5.7
Turnips and swedes	12.3	12.5	17.0	13.8	16.0
Mangolds	18.8	15.3	17.2	18.7	18.2

It will be seen that, except in the case of potatoes and mangolds, rather lower yields per acre are obtained in Great Britain than in Denmark. This is not apparently due to any marked difference in regard to either soil or climate. I understand that though there is excellent arable land and much fertile soil in Denmark there is also a good deal of light and poor land, and that it is doubtful if on the whole the soil is as good as that of this country.

The higher yield of wheat in Denmark is, however, due to the fact that this crop is only grown on a small area, and hence only on land specially suited to it. It is consequently natural that a higher return per acre should be obtained than in this country, where it is one of the principal crops and grown more or less on rich and poor soils indifferently. Thus in Denmark (1920-4) the area under wheat was only 198,000 acres, or about 3 per cent. of the total arable area, while in England wheat was grown on 1,778,000 acres, which is 17 per cent. of the arable area. The higher yield in Scotland is explained on this basis, as it occupies less than 2 per cent. of the arable area, though the argument will not apply to Wales. Corn crops of one kind or another are, however, grown annually on nearly one-half the arable area of Denmark, and the suggestion that these crops are grown on the most suitable soil cannot be taken as an explanation of the higher yields obtained generally. In the

'seventies, moreover, the Danish yields were rather below those of this country, but they have increased materially during the last forty years, though no similar increase is noticeable in this country. The Danish Agricultural Society attributes this to a general improvement in agricultural practice, and particularly to increased fertility of the soil resulting from the larger number of live stock kept.* Another writer, Mr. Rudolf Schou, refers especially to the introduction of heavy cropping varieties as a principal cause of the increasing yields, and it is certainly a fact that great attention is paid in Denmark to questions of seed testing and the production of improved varieties. So far as I am aware, there has been no change in the statistical methods of estimating yields in Denmark which would be likely to have any influence on the figures.

Live stock per 100 acres.

The second measure of relative productivity which is commonly adopted depends on calculating the number of live stock in different countries per 100 acres of crops and grass, and reducing these for simplicity to a common unit (*e.g.* 1 head of cattle = 7 sheep = 5 pigs).

We have here two possibilities of error. The use of a common unit into which different classes of stock are converted involves some assumptions which may not be altogether justified, and the risk of error is increased owing to the fact that, whereas Great Britain has very large flocks of sheep, in Denmark there are few. The result would therefore be appreciably altered by assuming either a larger or a smaller number of sheep to be equivalent to one head of cattle, and similarly with pigs. The rate of conversion mentioned above has, however, been adopted by many authorities, and the use of an equivalent unit of this sort is the only means of comparing numbers of stock.

The unit of 100 acres of crops and grass is also open to criticism, as, in addition to the land included under the heading of crops and grass, there are in Great Britain very large areas of mountain and rough grazing on which sheep, and to some extent cattle, are grazed, whereas in Denmark there is no very substantial area of land of this type. The effect of excluding land of this type is to increase the nominal head of stock maintained in Great Britain as compared with Denmark. This is a point which should be borne in mind throughout these comparisons, as on balance the tendency is in favour of Great Britain and against Denmark. The Danish figures refer to holdings

* "A Short Survey of Danish Agriculture." Report by the Danish Agricultural Society, 1913.

of over $1\frac{1}{2}$ acres in extent, while the British returns include holdings of over 1 acre.

Live stock per 100 acres of crops and grass in 1920-4.

(See notes below.)

	Cows and heifers.	Cattle, other kinds.	Sheep. (See note (2).)	Pigs.	Live-stock units (i.e. equivalent number of cattle).
Great Britain ..	9.7	12.6	66.6	8.7	33.5
England ..	9.5	11.6	44.6	9.9	29.5
Wales ...	11.4	16.4	123.1	7.9	47.0
Scotland	9.5	15.1	141.2	3.4	45.5
Denmark ...	22.0	10.1	5.5	25.5	38.0

(1.) The Danish returns include an area of 385,000 acres, or about 5 per cent. of the total cultivated area, which includes marsh-land and commons used for grazing, and is thus analogous to some of the land which in Great Britain would be included as "mountain- and heath-land and other rough grazings." If this land were excluded, it would tend to raise the Danish figures "per 100 acres" throughout. The cultivated area of Denmark is taken as 7,968,000 acres, and the cultivated area of Great Britain as 30,751,000 acres. The area of mountain- and heath-land in Great Britain not included in the foregoing figures is 14,416,000 acres.

(2.) The figures for sheep are not at all comparable, owing to the variation in the area of mountain- and heath-land available for grazing in the different countries. Thus, the additional area of this hill-land used for grazing and not included in the area under crops and grass is for each 100 acres of crops and grass: Great Britain, 47 acres; England, 14 acres; Wales, 56 acres; Scotland, 205 acres.

The effect of the exclusion of rough grazings is seen in the figures for both Wales and Scotland, which appear as heavily stocked owing to the large proportion of sheep pastured on mountain-land, while England taken by itself shows up rather badly. Denmark, it will be seen, has exceptional numbers of cows and pigs, far exceeding the figures for any part of Great Britain.

As in the case of crops, a comparison with past years shows considerable progress in Denmark and comparatively little movement in Great Britain.

Live stock per 100 acres expressed as cattle.

	1880-4.	1900-13.	1920-4.
Great Britain	31.2	35.1	33.5
Denmark	26.0*	41.0	38.0

* 1881.

The decline in this country between 1909-13 and 1920-4 is due to the decrease in the number of sheep. In Denmark the somewhat similar decrease is due to the heavy reduction in the pig population during the war.*

Gross production per 100 acres.

Passing from these two measures of productivity, we can approach rather nearer to the heart of the problem by attempting to estimate the actual weight of produce resulting on the average from the cultivation of a similar area of land. A comparison on these lines was made recently by Mr. Harald Faber in the *Journal of the Royal Statistical Society*, January, 1924.

The Danish figures are given below, together with later figures for Great Britain.

Production per 100 acres of crops and grass.

	Denmark.		Great Britain.	
	1909-13.	1922.	1909-13.	1920-4.
	Tons.	Tons.	Tons.	Tons.
Corn	32	32	16	17
Potatoes	12	17	11½	13
Meat	4½	4½	4	3½
Milk ..	48	46	17½	19

The higher figures for corn in Denmark are in part due to the higher average yield per acre, but mainly to the larger proportion of the cultivated land devoted to corn crops. In the same way, the larger milk production is partly attributable to the estimated higher average yield of milk per cow (550 gallons per annum in Denmark, against 440 gallons in Great Britain) and partly to the actually larger number of cows per 100 acres.

This does not, however, by any means represent the total production; there are, in addition, fruit, vegetables, eggs, wool and miscellaneous crops, while the production of corn is not wholly additional to the production of meat and milk, as part of the corn is used for feeding. These figures, therefore, while they draw attention

* Mr. Faber, in his paper (*Journal of the Royal Statistical Society*, January, 1924, p. 23), remarks that "The severe reduction in the stock of pigs during the war from 2,500,000 to 400,000 had not been completely overcome in 1922 (when the number per 100 acres was 24). The corresponding figure for 1914 was 35 pigs per 100 acres. It was 40 according to the enumeration on July 15, 1923."

to marked differences between Great Britain and Denmark, do not afford any real clue to the relative total production of the two countries.

What is needed is a means of expressing the total production of all agricultural produce in some common unit which will enable the output of all the various products to be added together. This was attempted by Sir Thomas Middleton in his well-known pamphlet, by the expedient of expressing the food products in terms of calories, a method which was of special interest and value during the war. It is not, however, altogether applicable to ordinary conditions, because the farmer does not regulate his business with reference to the calorie content of the commodities produced, but according to their relative profitableness, and consequently calculations based on calories are not directly connected with the practical questions involved. The unit which gets over this difficulty and seems most suitable as a measure of production is that of money, and I have therefore attempted a comparison of the output of this country and Denmark by the expedient of valuing the products of the two countries at the same average prices, and comparing the total value thus ascertained in relation to the cultivated area.

In the case of Great Britain, an estimate of the value of the output of the different groups of commodities is available in the *Agricultural Statistics* (Part II, 1923). This estimate represents the value of the produce sold off farms for consumption elsewhere. That is to say, it takes the land of the country as one huge farm and excludes produce used for feeding live stock or produce sold from one farmer to another, the object being to take account only of such crops and produce as are sold for consumption off the land. The estimate is largely hypothetical, in the sense that it depends on a large number of estimates on points in regard to which precise knowledge is impossible. At the same time it is a calculation which is carefully made, and one which, from a statistical point of view, should not have any serious margin of error. No one would claim precise exactitude for an elaborate estimate of this sort, but there is no reason to suppose a bias in any particular direction, and it should be approximately correct. When, however, the total is reduced to a rate per 100 acres of crops and grass, an error creeps in because, as explained above, the production is assumed to come wholly from the area under crops and grass, whereas in fact some part is drawn from the mountain- and heath-land outside the area returned as crops and grass. This error, which in the main affects the production of sheep, cannot be corrected with any accuracy. It is, however, all in the one direction, the effect on the total figures being to make

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the British production per 100 acres somewhat higher than it really is, possibly to the extent of from 3 to 4 per cent.

But the products included in this estimate are not entirely produced from the soil of this country, as considerable quantities of feeding-stuffs are brought on to farms which are either imported direct or manufactured from imported materials, as, for example, millers' offals from imported grain, or cake from imported oil-seeds. An allowance has also to be made for live animals brought in from Ireland to be fattened, for imported agricultural seeds, and for imported fertilizers.

An estimate on this basis for Great Britain is of no value for purposes of comparison unless a similar calculation can be made for Denmark. This is in the main provided by the remarkably detailed information supplied by Mr. Faber in his paper on "Agricultural Production in Denmark," which enables an estimate to be made on similar lines of the output of that country in terms of quantity. If, then, this estimated output of Danish produce is given the same money value as the British produce a comparison is possible between the two countries.

I should like here to acknowledge my indebtedness and to express my thanks to Mr. Faber for the information given. Without the details he supplied, the calculations made below would not have been possible.

Table I in the Appendix shows the estimated production and the estimated quantities sold off farms in Great Britain and in Denmark in the year 1922.* Table II shows the quantities sold off farms expressed in terms of money and the estimated quantities of each commodity both valued at the same rate, the values thus obtained being then reduced to a rate per 100 acres of cultivated land for purposes of comparison. The values attributed to the Danish produce do not, of course, in any way represent the value received by Danish farmers; the method adopted is merely intended to enable the various products—corn, meat, milk, etc.—to be added

* The year 1922 is given because that is the most recent year for which the necessary details are available. The selection of this year has, however, the advantage that it avoids all risk of exaggeration which might result from the selection of an exceptional year. Mr. Faber, in the paper above referred to, remarks that "The abundant harvest of 1923 and the very large increase in the number of pigs in that year, when pre-war conditions may be said to be re-established, would undoubtedly have more given favourable results. It should also be remembered that the Slesvig districts had not in 1922 recovered from the effects of the war, and have therefore depressed the results." In the case of Great Britain the production of crops was on the whole about 5 per cent. below average, and the number of live stock was also somewhat on the low side.

together and compared on a uniform basis which has a relation not to their bulk or weight, but to their relative value. The result would be approximately the same if the various items were valued in both cases at Danish prices and the comparison made in terms of the Danish krone instead of the pound sterling.

Summarizing the figures given in Table II per 100 acres, the results are as follows : -

	Value of quantities of agricultural produce sold off farms in Great Britain and Denmark respectively (taken at British prices in both cases).	
	Great Britain, per 100 acres.	Denmark (at British prices), per 100 acres.
	£	£
Corn	80.1	73.3
Potatoes	22.2	7.8
Roots, hay and straw	33.1	17.2
Hops, sugar beet and miscellaneous crops	45.1	40.1
Horses	6.0	8.8
Meat ...	341.5	392.0
Wool ...	10.5	0.8
Poultry ...	16.3	23.3
Eggs	34.9	103.8
Milk	219.4	447.4
Total	817.4	1,114.5

These figures represent the gross production, and as explained above, we have to deduct from them the value of the agricultural requisites imported on to the farms.

Table III gives particulars of the feeding-stuffs, fertilizers, seeds and store cattle valued in the same way.

These expressed in terms of per 100 acres work out as follows :—

	Value of agricultural requisites consumed on farms in Great Britain and Denmark (taken at British prices in both cases).	
	Great Britain, per 100 acres.	Denmark (at British prices), per 100 acres.
	£	£
Feeding-stuffs....	158.1	127.8
Fertilizers ...	18.8	33.0
Agricultural seeds	3.2	—
Store stock ...	25.0	—
Total ...	205.1	160.8

Taking these two groups of figures together, we reach the following result :—

	Great Britain, per 100 acres.	Denmark (at British prices), per 100 acres.
Total agricultural produce (gross) ...	£ 817	£ 1,115
Less agricultural requisites contributing to the production ...	205	161
Total agricultural production (net)	612	954

It appears from these figures that the Danish net output after deducting feeding-stuffs, seeds, and fertilizers, which contribute to the gross production, is over 50 per cent. higher than the British production calculated in the same way.

This is a very striking result, and in view of the complexity of the calculations involved I do not wish to place too much emphasis on the precise figure. One would indeed be disposed to criticize the calculation, were it not for the fact that an explanation of this very high figure is suggested at once from a merely superficial examination of the comparative statistics. *It lies mainly in the fact that, as compared with Great Britain, Denmark carries a heavier head of stock in combination with a high arable area, and by growing crops on this arable area feeds this stock to a greater extent from her own soil.* As Mr. Faber remarks, "it is characteristic of Danish agriculture that a very large proportion of the produce of the fields is converted into animal produce." This is combined with a higher yield per acre in the case of certain crops, with a larger yield of milk per cow, and with a larger output of eggs and poultry.

The imported feeding-stuffs used in Denmark represent about £3 7s. per head of live stock, while in Great Britain the similar figure is £4 15s. per head.* On the other hand, the consumption of artificial fertilizers in 1922 (at British prices) represented an expenditure of £33 per 100 acres in Denmark, against £18 16s. in Great Britain; though, as compared with net output, there is a fairly close resemblance, the value of the fertilizers employed representing 3 per cent. of net output value in Great Britain and 3·5 per cent. in Denmark.

* It should be noted that Denmark uses proportionately more maize and oil-cake than Great Britain, but less milling offals. The import of wheat into Great Britain is naturally larger, and this leaves a larger proportion of wheat offal available as food for stock.

Proportion of arable land.

The next step is to examine the figures of arable area in Great Britain and Denmark. The expression "arable land" includes not only land actually under the plough, but also land under clover and rotation grass which is due to be ploughed up in the rotation. There is a certain liability to error due to this cause, both because the length of the rotation varies and because land may continue to be returned as under rotation, although it has not been ploughed up at the right time. For example, if a farmer wishes to reduce his land under the plough, he does not necessarily lay it down to permanent pasture; the same object is for the moment secured, and fresh outlay avoided, by the simple expedient of leaving certain fields in rotation grasses for another year or two. The error from this cause is only of a temporary nature, but variations in the length of the rotation produce results which may be misleading. That is to say, with a long rotation in which fields are left in grass for three or four years, the proportion of arable is nominally much increased as compared with a four-course rotation, although the proportion actually ploughed in any one year may be the same. A more exact and precise guide is obtained by taking the actual tilled or ploughed areas excluding clover and rotation grasses, and in the following table figures are given by both methods :—

Proportion of cultivated land classified as "arable" and as "tillage"
(average of the years 1920-4).

Counties.	Arable.	Permanent grass	Tillage (i.e., arable, excluding rotation grasses)	Permanent grass and rotation grasses.
	Per cent.	Per cent.	Per cent.	Per cent.
Great Britain	47·8	52·2	34·9	65·1
England	45·7	54·3	36·3	63·7
Wales	27·6	72·4	16·8	83·2
Scotland	70·4	29·6	38·9	61·1
Denmark	83·0	17·0	58·9	41·1

The effect of a long rotation period on the proportion of arable is very apparent in the case of Scotland, where the nominal proportion of arable is 70 per cent. of the whole area, although the proportion actually tilled annually is only 39 per cent. This is due to the fact that rotation grasses in Scotland are left down for about three years, although they continue to be classed as arable because they will be ploughed up in due course.

The figures for Denmark show nearly 60 per cent. in "tillage"

as compared with 35 per cent. in Great Britain, and thus account for the higher gross productivity reached when estimating the actual production of that country. In a sense it is another way of stating the same thing. If it is admitted that the cultivation of land for corn, roots, potatoes and other field crops is on the average a more "productive" method of agriculture than the keeping of land in grass either for pasturing stock or for hay, then the mere fact that Denmark has a higher proportion of land under such cultivation constitutes in itself evidence of higher productivity. I need not produce evidence of the fact that land under tillage will generally give a greater gross production than land under grass, because it is, I believe, generally agreed that this is the case. The question whether it pays to obtain this greater gross production is another matter.

This smaller proportion of "tillage" in Great Britain is, however, no new thing, and although there has been a decline in the arable area in the last fifty years, tillage or arable cultivation was even fifty years ago less general than it is in Denmark at the present day.

A fairly exact comparison of the position at the two dates can be made by taking the distribution of crops and live stock per 100 acres, that is, the proportion of the total area returned at the two dates under various heads. This avoids any error which might arise from changes in the total agricultural area such as are caused by the withdrawal of land for building or other industrial purposes, or in the case of Denmark by the addition of land by reclamation.

The figures are given in the following table :—

	England.		Wales.		Scotland.		Great Britain.	
	1870-4.	1920-4.	1870-4.	1920-4.	1870-4.	1920-4.	1870-4.	1920-4.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Total arable ...	57.9	45.7	41.4	27.6	76.7	70.4	59.1	47.8
Permanent pasture	42.1	54.3	58.6	72.4	23.3	29.6	40.9	52.2
Total tillage ...	46.5	36.3	27.3	16.8	47.3	38.9	44.8	31.9
Total grass .	53.5	63.7	72.7	83.2	52.7	61.1	55.2	65.1
Corn . . .	32.0	24.2	20.6	12.6	31.4	26.0	30.8	23.4
Potatoes	1.5	2.1	1.8	0.9	3.8	3.2	1.8	2.2
Other cultivated crops	13.0	10.0	4.9	3.3	12.1	9.7	12.2	9.3
	No.	No.	No.	No.	No.	No.	No.	No.
Cows	6.5	9.5	9.5	11.4	8.6	9.5	7.1	9.7
Cattle	10.2	11.6	13.8	16.4	15.9	15.1	11.3	12.6
Sheep	78.6	44.6	107.4	123.1	156.6	141.2	92.6	66.6
Pigs	8.8	9.9	8.2	7.9	3.7	3.4	8.0	8.7
Stock expressed as cattle* . . .	29.6	29.5	40.3	47.0	47.5	45.5	33.2	33.5

* 7 sheep = 5 pigs = 1 head of cattle.

In the course of fifty years the proportion of land actually tilled or under the plough has decreased by 10 per cent.; that is to say, out of every 100 acres of agricultural land in Great Britain, 34.9 acres are now tilled as compared with 44.8 acres in 1870. Of this tilled area, 23.4 acres are under corn crops as against 30.8 acres in the earlier period; in other words, the bulk of the loss in the tilled area is due to the smaller extent to which corn crops are now grown. There are variations between England, Wales, and Scotland, but on the whole the movement is very similar.

In the case of live stock, there has been in the fifty years an increase in the number of cattle kept per 100 acres and also a small increase in pigs, while the number of sheep has appreciably decreased, with the result that the total head of live stock expressed as cattle in Great Britain is approximately the same.

In Denmark, on the other hand, the proportion of the total area which is tilled has increased from about 53½ per cent. in 1871 to 59 per cent. in 1919, while, as has already been shown, there has been a substantial increase in the number of live stock.

Comparison of the percentage distribution of crops and grass in Denmark in 1871 and 1919.

	1871.	1919.
	Acre.	Acre.
Arable land....	58.6	83.0
Permanent pasture	41.4	17.0
Tillage (excluding rotation grasses)	53.4	58.9
Grasses of all kinds	46.6	41.1
Corn	42.0	37.7
Potatoes	1.7	3.1
Other cultivated crops	9.7	18.1
	Nos.	Nos.
Cows	12.6	22.0
Cattle	6.7	10.1
Sheep	28.8	5.5
Pigs	6.0	25.5
Stock expressed as cattle	24.8	38.0

The movement as regards the tilled area has thus been in the opposite direction to the movement in Great Britain, the proportion of "tillage" having increased in Denmark by some 5½ per cent. and decreased in Great Britain by about 10 per cent.; so that the difference which already existed fifty years ago has become materially greater.

It is perhaps worth while pointing out that the difference between

Denmark and Great Britain, as regards the proportion of tilled land and live stock, cannot be accounted for by the larger area of the latter. It is true that there are parts of Great Britain (*e.g.* the Eastern Counties) where the proportion of tilled land approximates to that of Denmark, but in these areas the number of live stock is much less; there are other areas with a large head of stock, but then the proportion of arable is down. I have not been able to find any part of Great Britain where both the tilled area and the head of live stock are even approximately equal to the average of Denmark.

The following counties are examples of high proportions of tillage and of large numbers of stock per 100 acres :—

	Tillage.	Cattle.	Sheep.	Pigs.	Total (as cattle).
Cambridge	69	8.9	22.5	15.3	15.2
Norfolk	61	12.3	25.8	14.7	18.9
Lincoln (Holland)	72	14.7	7.2	13.3	18.4
Cheshire	25	35.2	10.8	12.8	39.3
Lancashire	24	29.1	38.1	10.4	36.6
Aberdeen	49	26.8	31.7	2.7	31.9
Banff	50	27.4	38.1	2.5	33.3

Cambridge, Norfolk, and Lincoln have large proportions of "tillage," but are not relatively heavily stocked.* Cheshire and Lancashire, on the other hand, have high proportions of live stock, but are mainly grass counties. The two Scottish counties of Aberdeen and Banff provide nearer approximations to the Danish proportions, but here the live stock are to some extent grazed on mountain- and heath-land.

To bring this survey of the comparative gross production of Great Britain and Denmark to a conclusion, it may be said that there is evidence that the output per 100 acres of Great Britain is at the present time materially less than that of Denmark. This appears to be due partially to the fact that the Dane finds it to his advantage to keep more of his land in tillage and to grow crops to feed his live stock, while in Great Britain the tendency is to reduce the land under tillage and to buy food from outside sources on which to feed stock. It is also due to the fact that Denmark has a materially larger stock of cows and pigs, which in terms of meat and milk give a greater proportionate return than is obtained by British live stock.

* The returns are, however, taken in June, and in these counties there is a movement inwards in the autumn, so that they are much more heavily stocked in the winter than in the summer.

There is also a substantially larger production of eggs and poultry. Accepting this as a broad general conclusion, we may now turn to a consideration of the question why this should be the case.

Number of persons employed.

Comparisons of the number of persons employed in agriculture in different countries are very far from straightforward, owing to variations in the methods of classification, but the following figures are believed to be approximately comparable :—

	Great Britain.		Denmark.	
	¶Farmers.	Farm workers.	Farmers	Farm workers.
Males	331,000	816,000	174,700	210,000
Females	24,400	73,000	10,600	58,300
	355,400	889,000	185,300	268,300
Total	1,244,000		454,000	

The Danish figures show that about 48½ men and about 8½ women are employed per 1,000 acres of cultivated land, wholly. It is of some interest to note that the larger number of persons employed on the land is fairly proportionate to the larger net agricultural output values in Denmark as compared with this country. If the agricultural employers (at British prices) be divided by the numbers of agricultural employers and workers, the relative output is £167 per head in Denmark and £151 in Great Britain. There is thus no very great dissimilarity between the Danish and British output per head of population employed, and these figures do not suggest that the large output of Denmark is obtained at the expense of any displacement of labour. This is a point of some importance, as it has often been suggested that the amount of labour applied per acre in foreign countries might not be so economic as the employment in Great Britain. If the figures given above can be taken in proportion to output is somewhat similar in the two countries.

Costs of production. of expenditure on

Costs of production are in the main made up of purchase of feeding-labour, rent, and interest on capital, and the poultry. With regard to stuffs, fertilizers, seeds and farm equipment generally the farmer has only to the latter items, it may be said that the Danish

the same opportunities of buying as are open to his colleague in this country, and that in a broad sense the price paid must be on the same basis. A difference of considerable importance is, however, that the Danish farmer buys co-operatively to a larger extent than is the case in Great Britain, and in this way may buy cheaper and thus reduce part of his costs of production.

As regards rent, the prevailing system of occupying ownership in Denmark does not enable us to make any comparison of rents, but the capital invested in the land, including the necessary buildings, is certainly no less than in this country. In fact, owing to the larger proportion of small holdings, it is on the average in all probability higher, and the interest at a moderate rate probably represents a higher charge per acre or per 100 acres than the average sum paid as rent in Great Britain. The Danish Bureau of Farm Management has for a number of years been collecting very careful accounts of farms in different parts of Denmark, and these furnish some interesting figures,* though changes in the exchange value of the krone present difficulties in any comparison with English money. Taking the exchange at par, it appears that the average capital shown in these returns for 1917-23 was about £63 per acre, of which about £28 buildings, and value of the land, nearly £17 as the value of the on a uniform basis or £19 as working capital. These values are taken in the value of the land each year. If allowance were made for the rise at commercial value of land, buildings, and stock, and the whole estimated cent. These figures, the figures would be increased by about 28 per to have been about refer to holdings of which the average size seems

It is questionable 110 acres.

figures with which to whether there are any reliable British or English the land and buildings these can be compared, but taking the value of and charging interests in Denmark at an average of £15 per acre, charge for interest (at, say, 4½ per cent., there would be an average would in this country (part from the cost of repairs) in respect of what is probably above the landlord's capital of, say, 40s. per acre, which of holding. So far the average rent in this country for the same class safely say that therefore, as rent is concerned, I think we may has to bear, directly equivalent charges which the Danish farmer of rent by occupier or indirectly, are not less than is paid in the form

The next consists in this country.

and here comparable item in the costs of production is labour, Appendix to the report is more difficult. Sir William Ashley in an "The wages of Report of the Tribunal (p. 268), observes that

* *Undersøgelser af landbrugsarbejdernes løn* (Agricultural labourers not boarded by the farmer

over Landbrugsarbejdernes Driftsforhold, vii, 1922-3, p. 33.

would seem before the war to have been slightly less nominally—perhaps 5 per cent. less than in England. But food was slightly more expensive in Denmark, so that the real wages of agricultural labourers in Denmark would work out at 93·5 per cent. of the real wages in England.*

The average wages of male workers in agriculture in England and Wales in 1914 were about 18s. per week, or £46 16s. per annum. In Denmark they appear to have averaged 376 kr. (with board and lodging), equivalent to £21, which, with board at 8s. 6d. per week, makes a total of about £43, or 8 per cent. less than in this country. This agrees fairly well with Sir William Ashley's figure referred to above. For day labourers permanently employed and boarding themselves, the rates worked out at 722 kr., or £40 2s. per annum, but this appears to have been for a six-day week, whereas the former figure may have represented a seven-day week, or, at any rate, have been in respect of some labour on Sunday.

After the war a system of collective agreements as to wages was introduced, and the total annual wages of resident male workers were fixed at 758 kr. in 1923-4 (May to April) and 891 kr. in the following year. Higher rates were paid, as in Great Britain, for stockmen and other skilled workers.

These rates show an increase on pre-war wages of from 102 to 137 per cent. The increase in the cost of living in Denmark in 1923-5 varied from 104 to 121 per cent. above pre-war, so that the Danish labourer may be slightly better off than before the war. As his wages at that time were slightly lower than the average in England, it seems possible that the position is now fairly similar in both countries. The average weekly wage in England and Wales has not risen to anything like the same extent as in Denmark, but neither has the cost of living nor wholesale prices generally. On the whole, from the point of view of the Danish farmer, I should imagine he is paying rates which are comparable in real value with those payable in this country. If these Danish rates were converted at the current rate of exchange, however, they would be appreciably below English rates, while equally, if converted at par, they would be appreciably above. In the case of a comparison of wages, however, it seems to me the comparative cost of living is the main factor, and not the rate of exchange.

Assuming that the cash wages in the two countries are more or less similar, the labour bill per acre in Denmark would

* He adds: "Those are the calculations of an impartial Swedish enquirer. But the elements in the calculation, especially those of garden produce, local prices and local dietary habits are too uncertain to permit much value to be attached to such comparisons."

naturally be higher, because a larger number of persons are engaged in the work of production. There seems some indication that this is the case, though the exchange problem and the difficulty of estimating the average labour bill in Great Britain make comparison very uncertain. The following table taken from the Danish costings is, however, of considerable interest in this connection, as it provides separate figures of the value per acre represented (a) by payments to farm servants, that is, hired labour; (b) by family labour; and (c) by the work of the farmer or occupier himself. The figures in this table, which refer to the year 1922-3, are converted at par (18 kr. = £). The actual rate of exchange at that period averaged 21·8 kr. = £.

No. of holdings.	Average size of holding	Rate per acre.			
		Farm servants.	Family labour.	Remuneration of farmer or overseer	Total.
	Acres.	£ s.	£ s.	£ s.	£ s.
45	14½	1 13	6 18	1 16	10 7
88	39	3 5	2 1	1 16	7 2
121	61½	3 16	0 19	1 15	6 10
154	94½	3 16	0 12	1 13	6 1
74	161½	3 8	0 4	1 9	5 1
52	557	3 8	—	1 0	4 8
534†	125½	3 8	1 7	1 12	6 7
500‡	115	4 2	1 11	1 15	7 8
† Average, 1922-3.		‡ Average, 1921-2.			

For the purpose of comparison with English wages it is only the expenditure under the head of farm servants which has to be taken into account.

No such exhaustive agricultural costings are available in this country, but an approximate figure can be obtained by taking the average number of persons employed in England and Wales, viz., 24 per 1,000 acres, and estimating their average wages (including stockmen, etc.) at 35s. per week. This gives an average labour charge of 45s. per acre.* If we make allowance for Scotland, where wages are higher, and raise this figure to 50s. per acre, we still have a rate appreciably below the £3 8s., which seems to be an average rate in Denmark.

* Two quotations may be given from agricultural costings in this country, but they are both based on a very small number of farms. Mr. Venn, of the Cambridge School of Agriculture, puts the labour costs on fourteen East Anglian farms, averaging 196 acres each (mainly arable land) at £2 15s. per acre, and on a further six farms at an average of 37s. 6d. per acre. Dr. Ruston, of Leeds University, gives the labour bill of twenty-nine farms in Yorkshire, with an average area of 197 acres, as £3 12s. per acre

The real difficulty in comparing wages, however, is that what we need to compare is efficiency or effectiveness in result, and bearing on this there is the further point that the English rates and Danish rates are probably not comparable as regards the number of hours worked.

All these figures of costs of production are admittedly vague and indefinite, though the general tendency is to suggest that there is not any very serious or material difference between Denmark and Great Britain as regards the main items. The evidence is, however, too indefinite to enable any final conclusion to be reached, and it may well be that the costs of production in Denmark are really and effectively lower than in Great Britain owing to such causes as (1) the co-operative purchase of fertilizers, feeding-stuffs, seeds, &c. ; (2) cheaper labour, due not actually to lower cash wages, but to longer hours or greater efficiency ; and (3) greater personal labour on the part of the producer.

Prices and relative profitability.

The real crux of the problem, however, lies not in the gross or net output, or even in the costs of production, but in the net return or profit to the producer. Whether the British farmer is, or is not, securing from the soil as great a quantity of produce as is obtained by farmers in other countries, he is presumably producing as much as it pays him to produce at current prices ; for the object of the farmer, whether in Denmark or in this country, is to earn a living, and his agricultural methods are those which in his opinion are most likely to give him the largest return. We come then to the question, if a large gross production and a large arable acreage tend to the agricultural prosperity of Denmark, why is not the same system applicable to this country ? Apart from the question whether costs of production are really and effectively lower, there are two other possible explanations, viz. (a) the prices received by the Danish farmer may be higher ; and (b) the Danish farmer may be content with a smaller return for his capital and labour than the British farmer.

As in the case of feeding-stuffs, fertilizers, &c., it is obvious that as the Dane sells very largely in the British market there can be no fundamental or basic difference in the price obtained for similar articles at the same time. But there may be an actual difference in the returns for several reasons. The Danish farmer may produce and sell a higher grade of article, and thus obtain a higher price ; by improved methods of marketing, he may obtain a larger share of the total price ; and by a selection of certain classes of output, all

yielding a profit, he may secure a larger average return on his total production.

These three reasons, taken together, probably constitute a partial explanation of the difference between the position of the Danish and the British farmer. Unfortunately, they are hardly susceptible of proof. The main products of Danish agriculture are butter, bacon, and eggs, and in each of these products the quality is very high, with the result that high prices are realized. The British farmer, however, in the main depends on fresh meat and fresh milk, with a certain amount of wheat, barley, and other products. Direct comparison is hardly practicable, and all that can be suggested is that by concentrating on a limited number of products of high quality, and by co-operative methods of marketing, the Danish farmer manages to secure a higher *average* return than is obtained by farmers in this country. It is by no means certain that this is the case. The sale of butter is not as a rule so remunerative as the sale of fresh milk for human consumption, and the value received for milk made into butter in Denmark in 1923, after deducting costs of manufacture and marketing but allowing for by-products, seems to have been lower than the farm value of British milk sold for human consumption. In the case of eggs, however, the Dane probably realized better prices than the average British producer, and in the case of pigs sold for bacon, I have been told that the average price realized by the farmer in Denmark for similar quality is higher than in this country. But, obviously, it is impossible to make any general comparison.

The effect of the export trade of Denmark on the general standard of quality, and hence of price, is, however, worth bearing in mind. The export trade has made it essential for Danish agriculturists to maintain a high grade of quality and has led them to adopt a legal system of control in respect of butter, eggs, cheese, and meat intended for export, while in the case of seeds and some other products practically the same result is secured by voluntary measures. Thus not merely a limited number, but a large proportion of Danish producers, are forced, if they wish to continue in business at all, to attain an exceptionally high standard of quality, with the result that they secure a high average price.

Although it does not seem possible to compare prices, some information is available as to the net profit obtained on Danish farms, which shows broadly that on farms of 75 acres and upwards during the years 1917-23, after deducting cost of production and interest on capital, there was a balance of 30s. to £1 an acre. This does not represent a large net profit, but it shows that, except on

the very small holdings, the Danish farmer was securing a moderate return for his capital and labour.

It has to be remembered that this figure is wholly net profit, as allowance has been made in the cost of production for the value of the occupier's own labour; while as the occupier, in a large proportion of cases, is also the owner, he receives in addition the return for interest on capital less, of course, payments he may have to make in respect of any mortgage or burden on property.

Conclusion.

If we now attempt to summarize the information, we may regard it as proved that the gross agricultural production of Denmark is higher than that of Great Britain, and that this greater agricultural production is secured by keeping a larger proportion of the cultivated land under the plough and maintaining a larger head of live stock. The result of this larger cultivation is that the live stock are fed to a greater extent on the products of the soil and a smaller proportionate quantity of feeding-stuffs imported than in Great Britain. Thus the net productivity of Denmark from its soil as closely as it can be calculated is over 50 per cent. greater than that of Great Britain.

The proportion of land under the plough in Denmark is approximately 60 per cent. of the agricultural area against 35 per cent. in this country. This necessitates and results in a larger employment of persons on the land to the extent of about 57 persons in Denmark against 40 in Great Britain, but this larger employment is approximately proportionate to the larger output.

What is the explanation of these differences between the two countries? The conditions as regards crops, climate, soil, markets, etc., are very similar, yet agriculture in Denmark is able to make a proportionately larger contribution of food-stuffs and to provide employment for a much larger number of people than is the case in Great Britain.

If the Danish costs of production were for some reason definitely lower than the British costs, or, alternatively, if the average Danish prices were higher, these would be obvious explanations. But it is not clear that Danish wages or rents differ very materially from those ruling in this country, though the cost of production may be reduced by savings consequent on the co-operative purchase of farm requisites. In the same way, while it is difficult to say definitely that Danish prices are higher, receipts from sales are certainly increased by improved methods of marketing and by the co-operative sale of produce. There can be no doubt that these are important factors, but they cannot, I think, be regarded as more than partial explanations.

There remains the possibility that the Danish farmer on the average is content with a smaller cash profit, or alternatively is willing to work harder or more energetically to secure a similar return.

It is certainly reasonable to suppose that the system of small ownership existing in Denmark may encourage the acceptance of a smaller average cash profit than is the case with the English system of larger farms held on annual tenancy. It certainly stimulates the occupier to more active effort. In the Danish case, the whole life of the owner is centred in his farm; in it he invests his savings and he spares no effort to secure the maximum result. In the English case, on the other hand, the capital is provided partly by the landowner and partly by the tenant, with the result that there is less inducement, both to the owner and to the tenant, to invest additional capital. The very cheap rate at which capital is provided by the landlord in Great Britain is an advantage to the tenant, but the system has a different psychological effect.

The British farmer, on the whole, regards his farm as a money-making machine in which he invests such capital, labour and enterprise as he expects will give him a cash return comparable with what he can get elsewhere. The Danish farmer, on the other hand, is more inclined to look to the average result and to the long-period increase in the capital value of his farm. The mere fact that he is the owner encourages him to put more capital, more labour, and more enterprise into his undertaking over an average of years than the British farmer.

This investment of capital by the Danish farmer, whether in cash or in labour, is probably a very important factor in the difference between the two countries. Apart from the sentiment attaching to ownership, the investment of capital is encouraged in Denmark because agriculture is its main industry, and there being relatively little competition from other industries capital tends to flow into it at a cheap rate. Moreover, capital invested in agricultural land usually returns only a low rate of interest, so that the owner of land in Denmark is probably content with a rate of profit on his whole undertaking, which is lower than the British farmer expects as a tenant.

On the whole, therefore, I am inclined to suggest that it is the size of the holdings combined with the psychological effect of ownership, which is the real source of the difference between the two countries.

In conclusion, I should like to acknowledge the assistance of Mr. F. Grant, of the Statistical Branch of the Ministry of Agriculture, in the preparation of the statistical part of this paper.

APPENDIX.

TABLE I.—*Estimated production and estimated quantities of produce sold off farms in Great Britain and in Denmark.**

Commodities.	Great Britain.		Denmark.	
	Production.	Quantity sold off farm.	Production.	Quantity sold off farm.
Thousands of tons.				
Wheat	1,742	1,219	248	170
Rye	—	—	357	261
Barley ...	1,096	767	652	61
Oats ...	1,932	386	834	108
Mixed corn ...	71	14	373	37
Beans	192	96	—	—
Peas ...	57	29	—	—
Potatoes ...	5,203	3,902	1,319	357†
Turnips and mangolds ...	26,382	2,638	7,658	383
Clover hay	2,410	602	629	63
Meadow hay ...	4,281	1,070	740	74
Wheat and barley straw ...	3,457	518	1,930	193
Oat straw ...	2,995	449	1,190	119
Hops	15	15	—	—
Sugar beet ...	—	—	503	375
Millions.				
Eggs	1,300	1,260	1,002	972
Million gallons.				
Milk	—	1,318	791	747
Thousands of tons.				
Beef and veal	488	—	126	—
Mutton and lamb	204	—	9	—
Pig-meat ...	288	—	167	—
Poultry ...	29	—	11	—
Thousands of lbs.				
Wool	64,550	—	1,300	—

* As explained on p. 222, the figures for Great Britain are based on estimates made by the Ministry of Agriculture, while those for Denmark are taken from Mr. Harald Faber's paper (*Journal of the Royal Statistical Society*, January, 1924), except in the case of one or two items, for which information is not given. In these instances approximate estimates have been made.

† Potatoes, though largely grown in Denmark, are used to a greater extent for feeding live stock than is the case in Great Britain.

TABLE II.—*Quantities sold off farms in Great Britain and Denmark valued at British prices.*

Commodities.	Great Britain, total value.	Denmark, total value.	Great Britain, per 100 acres.	Denmark, per 100 acres.
	£ (thousands)	£ (thousands)	£	£
Wheat	11,580	1,620	37·7	20·3
Rye	—	2,220	—	27·9
Barley	7,800	620	25·4	7·8
Oats	3,670	1,030	11·9	12·9
Mixed corn	130	350	0·4	4·4
Beans	990	—	3·2	—
Peas	450	—	1·5	—
Potatoes	6,830	620	22·2	7·8
Turnips and mangolds ...	2,640	380	8·6	4·8
Clover hay	3,160	330	10·3	4·1
Meadow hay	4,900	340	15·9	4·3
Wheat and barley straw	450	170	1·5	2·1
Oat straw	560	150	1·8	1·9
Hops	3,160	—	10·3	—
Sugar beet	—	1,060	—	13·3
Miscellaneous crops	10,800	2,140	35·1	26·8
Horses	1,860	700	6·0	8·8
Beef and veal . .	48,090	12,550	156·4	157·5
Mutton and lamb	27,610	1,190	89·8	14·9
Pig-meat	30,240	17,500	98·3	219·6
Wool ...	3,230	60	10·5	0·8
Poultry ...	5,030	1,860	16·3	23·3
Eggs	10,720	8,270	34·9	103·8
Milk*	67,470	35,650	219·4	447·4
	251,370	88,810	817·4	1,114·5

* The total quantity of milk produced, other than that used for calves and pigs, has been valued at British liquid milk prices on the farm, but deductions have been made for the estimated quantities of skim or separated milk, butter milk and whey used on farms for feeding stock.

TABLE III.—*Agricultural requisites of foreign origin valued at British prices.*

Agricultural requisites.	Great Britain, quantity.	Denmark, quantity.	Great Britain, value.	Denmark, value.	Great Britain, per 100 acres.	Denmark, per 100 acres.
	Thousands of tons	Thousands of tons.	£ thousands	£ thousands	£	£
Wheat	—	41	—	390	—	4.9
Barley	416	5	4,230	50	13.7	0.6
Rye	—	107	—	910	—	11.4
Oats	231	—	2,200	—	7.1	—
Maize	1,347	400	12,120	3,600	39.4	45.2
Maize meal	98	1	950	10	3.1	0.1
Rice meal	99	1	760	10	2.5	0.1
Oilcakes	1,166	401	12,240	4,210	39.8	52.9
Milling offals	1,648	83	13,180	660	42.9	8.3
Brewers' grains	346	40	2,940	340	9.6	4.3
Total	—	—	48,620	10,180	158.1	127.8
Fertilizers—						
Synthetic nitro- genous	—	70	—	950	—	11.9
Sulphate of ammonia	130	—	2,080	—	6.8	—
Nitrate of soda	30	32	450	480	1.5	6.0
Superphosphate....	430	250	1,830	1,060	5.9	13.3
Basic slag	265	14	800	40	2.6	0.5
Potash	180	30	630	100	2.0	1.3
Total	—	—	5,710	2,630	18.8	33.0
Agricultural seeds	—	—	990	—	3.2	—
Irish store cattle	No. 558,000	—	£ 7,670	—	£ 25.0	—

DISCUSSION ON MR. THOMPSON'S PAPER.

SIR HENRY REW: It gives me special pleasure to be allowed the opportunity of moving a vote of thanks to an old colleague of mine. We worked together in the old days, and even now our association has not altogether ceased. It might possibly be thought that for this reason my observations upon this paper would be made in a somewhat partial spirit. But of course, in the Statistical Society, we know no partiality; we subject our friends—and delight in doing so—to criticism as freely as we should those who may not be numbered amongst our acquaintances. In any case, this paper is one upon which my remarks will be rather of an interrogatory than of a critical nature.

There are one or two questions I should like to put to Mr. Thompson on points that have struck me in reading his interesting paper. The subject of comparison between Great Britain and Denmark is not a new one. Mr. Thompson says that "it might well be supposed that nothing new could be said on the subject." There have been not only a good many comparisons made, but a good many conclusions drawn, and the conclusions have not always been of the same tenor, and are sometimes conflicting. In his first paragraph Mr. Thompson indicates one of the pitfalls into which some have fallen. He speaks on the one hand of the total output of the soil, and on the other hand of the return of practical farming. Of course, the gross output from the soil of a country is one thing, but, having arrived at what may, or may not, be a derogatory comparison to one country or the other, to assume that the comparison implies a reflection on all practical farmers in the country concerned is, I think, somewhat unfortunate. I believe that of no country can it be said that every farmer is of the highest efficiency, or that all land is used to its maximum capacity. There are exceptions in every country to whatever may be the standard. We need to think of the general average of a country, and not to assume that, because the average in one may be a little higher than in another, therefore all those who go to make up the average are necessarily doing better in the one than in the other.

I feel that although we are glad to have this contribution from Mr. Thompson at the present time, it is rather unfortunate that the period necessarily taken is not altogether a satisfactory one. The period 1920-4 can hardly be described as a normal period in either country, either in relation to its agriculture or any other part of its economic life.

With regard to the formula taken to get a live-stock "unit," I think the basis is simply the average live weight of the respective animals; that is to say, it is assumed that 7 sheep or 5 pigs will weigh about the same as a single head of cattle.

I must say that the little table on p. 221 giving live stock per 100 acres expressed in units of live stock, is, from the point of view of Great Britain, disappointing. It appears that, as

compared with the pre-war period, Great Britain has not recovered her position as regards live stock. The same applies to Denmark. That reduction would seem to be rather serious, but we must take into account the fact that the period 1920-1 cannot be regarded as really having brought us back to our normal position. It certainly has not in the case of sheep, which have only just begun to return to their pre-war level.

In the point dealt with on p. 222, I wonder whether Mr. Thompson relies upon estimates which he, with a good deal of enterprise and some degree of courage, publishes year by year—the estimates of the total output of the land of this country. I understand an enquiry is now being made in connection with the Census of Production, and it will be extremely interesting to know whether or not the results will confirm—as they possibly may—the calculations made from time to time and published in the agricultural statistics. As Mr. Thompson clearly points out, some of these estimates are very difficult to make, and one cannot be too thorough in research before attempting to establish a figure. Take such a figure as the average yield of milk per cow. No one knows better than Mr. Thompson how extraordinarily difficult it is in this country—more so than in Denmark—to obtain this figure. In Denmark the cattle are more homogeneous than in this country, where the range extends from the cow that does not contribute a single gallon to the milk supply to the cow that contributes a thousand. Thus the difficulty of arriving at a fair average figure of yield per head is probably greater than in Denmark.

In this connection I cannot help thinking—though I have no statistical grounds for expressing doubt—that in comparison with a country like Denmark the amount of produce in this country coming under the heading “miscellaneous crop,” and referred to as “fruit, vegetables and so forth”—i.e. the products of intensive farming—is not yet adequately known. As compared with Denmark, I should have expected to find the relative amount of that kind of produce in this country greater than is shown in the figures given by Mr. Thompson.

I am interested in the reference to the calculations with which we were familiar at one time, and for which Sir Thomas Middleton was to a large extent responsible, expressing output in terms of calories. I should like to ask Sir Thomas Middleton whether now it would not be almost as true and helpful to the public at large if one expressed comparisons in terms of vitamins instead of in terms of calories, or whether it would be possible to combine the two and to obtain some formula which would enable an even more satisfactory comparison of food values to be made?

Mr. Thompson deals, I think quite fairly, with the amount of imported food-stuffs, fertilizers, etc., used on the farm. That subject was brought before the notice of the Society some years ago by the late Sir Richard Crawford. Mr. Thompson's doctrine seems to me to be quite sound, but I would rather like to ask him whether in the

comparison on p. 225, in the small table, the figures in both cases are actually confined to imported agricultural requisites. Reading from the text, it would appear that that is the intention, but it does not actually say so in the heading of the table.

There is one other question I would like to ask. On p. 227 a discrimination is made between arable lands, as returned in the statistics, and tillage. I am not quite clear on this point, but it seems to me that Mr. Thompson has taken out the whole of the land which is at any time under "seeds," and does not include it as arable at all, though possibly I may be wrong in my reading. Quite clearly the "seeds" are ploughed up from time to time; therefore, when he tries to arrive at the amount of land ploughed up in any year, it seems to me that the calculation has gone a little too far. I put this forward, however, with a certain amount of hesitation, as I am not quite clear as to what has been done.

There is another point which perhaps Mr. Thompson will be good enough to verify. I have no doubt that the figures are correct, but they look to me a little remarkable; I refer to the table on p. 229, which, as I understand it, shows that Denmark has greatly increased her arable area, as ordinarily interpreted, and very considerably increased her tillage area, but at the same time has substantially decreased her corn crops. This does not seem to me to be fully explained by anything in the text.

In the comparison of labour on the farm, on p. 231, I should be interested to know exactly how the number of farmers is made up in each case. The number of farmers given for Great Britain does not seem to agree with the Census or with the number of holdings as returned in agricultural statistics, and it is probably made up of the number of farmers occupying over a certain acreage. It appears, however, that in Denmark in that particular year there were 889,000 farmers occupying 4 acres and over, and I assume that Mr. Thompson has made the Great Britain figures agree as nearly as possible with that same distinction.

There is another point in connection with labour. The total number of farm workers in Great Britain includes 20 per cent. of what are classed as "casual labourers," who work on the farms for a very varying period of the year, ranging from a few weeks to a few months. It would be interesting to know if there is a similar class in Denmark, and, if so, has any allowance been made in either case for the loss of labour in the year by reason of the fact that they are only partly employed?

Mr. Thompson suggests an average labour charge of 45s. per acre in this country, as compared with £3 8s. in Denmark, which, in view of the fact that Denmark has roughly 50 per cent. more output, appears to be consistent with the greater proportion of arable land in Denmark compared with this country.

With regard to Mr. Thompson's explanation of how export trade had led the Danish farmer and, in fact, compelled him to adopt certain methods of grading and marketing his produce, perhaps it

should be more emphasized that, with all our admiration for the Danes, we have to remember they could not help themselves. They were forced to adopt "orderly marketing" by the nature of the case. There is no option when the produce is practically all going out of the country. Our farmers have an option, and in many cases they prefer a disorderly system to an orderly one while there is no compulsion to adopt an orderly system.

In conclusion, as Mr. Thompson points out, interesting as this detailed comparison is, rather fascinating as some of the points are, it is practically summed-up in the statement that Denmark has 50 per cent. more arable land than we have. That accounts for nearly the whole of the facts, but we are still in the dark as to why Denmark has 50 per cent. more arable land. It would be extremely interesting to try to probe that problem to the bottom. Of course, the usual answers would take one outside the range of this Society into another atmosphere, but the particular answer that is popular in some quarters does not apply here. It was freely said that the greater proportion of arable land in Germany was due to protection, but that explanation cannot be applied to Denmark. Although Mr. Thompson's paper has thrown a great deal of light upon a most interesting problem, it still leaves that great question unanswered.

I have the greatest possible pleasure in moving a cordial vote of thanks to Mr. Thompson.

LORD BLEDISLOE: I have very great pleasure in seconding this vote of thanks to my departmental colleague, Mr. Thompson, partly because I am myself an ardent Danophile, and partly because he has obviously devoted an enormous amount of his own ability and energy to the task of drawing up this paper.

We cannot fail to be interested in Denmark, seeing that our butter, bacon and, to an increasing extent, our eggs come very largely from that country, and are of remarkably good quality and of wonderful uniformity. In fact, I sometimes wonder, when I hear of a contemplated Merchandise Marks Bill which is intended to place a mark of origin upon certain foreign agricultural produce, whether, unless we manage to some extent to imitate Danish methods, we may not find the public putting a premium upon the foreign commodity. It is a very remarkable result which Mr. Thompson deduces from the official figures, viz. that there is a 50 per cent. greater food output in Denmark than in Great Britain, and the cause of the difference, according to him, is summarized in his last paragraph, in which he suggests that it is the size of holding combined with a psychological effect of ownership. With that I personally agree, but I should have added three other factors: (1) The more thorough and suitable education of Danish farmers and farm workers; (2) cheaper transport; (3) a different system of land taxation.

In considering the figures, it is rather interesting to note that Mr. Thompson's table on p. 219, which refers to the average yield per acre of different crops in England and Denmark respectively,

discloses the fact that the difference in wheat production in favour of Denmark is 30 per cent., in barley 25 per cent., and in oats 5 per cent., and incidentally I should like to observe that I think that the climate has something to do with these differences. The drying winds of Denmark are a very important factor in Danish production, and particularly in the harvesting of their crops. At harvest time these drying winds—nearly always prevalent—enable them to recover from the effects of their atmospheric humidity much more rapidly than we do. Seeing that ours is on balance a humid climate, we naturally find that in the matter of oats we succeed better than in that of the other two cereals. In the matter of potatoes there is no great difference; Denmark shows slightly smaller yields than England. The figures of Great Britain are much about the same, because Scotland and Wales seem to more or less cancel each other. I should like to mention, however, that potatoes in Denmark are grown mostly in Jutland and on poorer soil, whereas our larger potato culture is in rich soils, such as that of Lincolnshire and Cheshire. There is a slight numerical difference in the matter of root output, but I am inclined to think—I speak with some little hesitation—that the difference in Denmark is greater than the figures show, because in the case of mangolds and swedes, to which a great amount of research has been contributed in Denmark, the actual dry matter derived from their roots is probably greater than what is derived from ours, although we have a greater bulk per acre, our roots containing a larger percentage of water.

I notice that Mr. Thompson said these results are not due to any marked difference in regard to either soil or climate. As regards climate, apart from the winds, on the *average* the Danish works out much the same as our own, but it is in fact rather colder in winter. Denmark suffers much more in winter from conditions of extreme cold, such as we have lately experienced, than we do normally in this country, and it is also rather hotter in the summer. The frosts, with which the Danes are more familiar than we are, kill insect pests and pulverize stiff and intractable soils, and therefore these are not so common in Denmark as in this country. There is a shorter and quicker period of growth. One result of this relative coldness of climate is that the cattle are housed for seven months of the year and, speaking generally, most of the pigs are housed the whole of the year. This may conduce to tuberculosis, but it saves food; the so-called "maintenance ration" for keeping up animal heat and vigour is materially less in Denmark than in England or Scotland.

Mr. Thompson says that the high yield of crops in Denmark is due to the crops being grown on small areas. I think that there is another reason, and that is the increased use of fertilizers on the larger farms. I estimate myself that the larger farmers in Denmark use something like three times the amount of nitrogenous fertilizers that we do in this country. The small men, who are the most numerous—75-80 per cent. of the whole—do not use much fertilizer.

There is another important point. As a rule we grow milling

varieties of wheat; they, on the other hand, grow heavy-cropping feeding varieties, much softer, and most of them unfit for use in English or Scottish mills, such as *Trifolium Tystofte* and Swedish Iron. From a milling point of view they are not wheats of the same class as Red Standard, Square Head Master, or (above all) Yeoman.

I rather wish that Mr. Thompson had made a little more reference to eggs and poultry, because the increase in the production of eggs and poultry is very marked in Denmark, and we are importing a large quantity of Danish eggs into this country.

I agree with Sir Henry Rew in his remarks as to the division of persons employed into farmers and farm workers, and I also should like to ask whether that figure for farm workers includes what I should call the "peasant proprietors," or farmer workers, who are the preponderant force in Danish agriculture.

As regards the net profit obtainable from farming, during my recent visit to Denmark with the late Minister of Agriculture, now Viceroy-designate of India, I took some pains to find out what profit was being made by the different classes of Danish agriculturists, and, to take the two extremes, I have a case on record where one of the Juels family, farming an area of 1,100 acres in north-east Funen, appeared to be making a net profit equivalent to £10,000 (sterling) per annum—that is, without reckoning the annual value of the land, which I found it quite impossible to estimate. He complained bitterly of the land taxation, which appeared to me, from an English standpoint, to be not very unreasonable. I am not sure that Mr. Thompson does sufficient justice to the smallholder. We found a man in south-west Zealand—which is being largely developed for small holdings under the present Labour government—who farmed 30 English acres, and who said that he put by during the last year no less than £60 out of that small area of land, after maintaining himself and his wife and family in health and comfort. That is a very remarkable result.

In any comparative examination of British and Danish farming reference should be made to transport, which is much cheaper in Denmark than in this country. There is one thing that impresses one in Denmark, and I am sure that if Sir Henry Rew were to come out with me next summer he would also be impressed. The farmer has more time to attend to his farm as a result of co-operative organization; the market is brought to him instead of his going to the market; what the Danish farmer criticizes most of all in our methods is the amount of time that the English farmer spends at market.

The number of paid farm workers is in fact relatively small; in most of the small farms the worker is his own master. I regard the Danish worker as 40 per cent. more efficient than the British farm worker. He is better and more suitably educated and his work better organized. He works much faster and with far greater interest and enthusiasm in his work. I believe that this is chiefly because Danish agricultural labourers have a better outlook; in nine cases

out of ten they know that if they are at all efficient they will become occupying owners themselves.

Perhaps it is dangerous for me to say so, but in my judgment there is no civilized country where the really competent agricultural worker has a poorer outlook than he has in this country, whereas I believe the incompetent worker is more generously treated in this country than in any other country in the world.

Sir ROBERT BALFOUR said that he did not think he could contribute much on the subject under discussion, but he had read Mr. Thompson's paper with great interest. It showed a very keen insight into the problems with which it dealt, and great impartiality, which was a valuable point. He himself was in the unhappy position of being a farmer—an occupying owner of about 860 acres—and he thought he produced just about as much per acre as was produced in Denmark, but he did not produce the same things. He was not engaged in the production of milk, excepting for his own requirements. The position of the milk-producing industry in Great Britain was very different from that in Denmark. The British dairy farmer was selling milk as milk, whereas in Denmark it was converted into butter for export. The British milk producers did not get adequate prices for their production; in his view there was too much difference between the wholesale and the retail prices. The retail marketing of milk was a difficult problem, and doing so on a co-operative basis would not be a simple proposition.

Mr. Thompson's comparisons were very interesting and valuable, but, as he himself had said, they have to be taken with reservations.

The production of wheat in Great Britain was something about 6 million quarters, in addition to seed requirements, and it was doubtful whether much more than 3 million quarters of home-grown wheat were used for bread-flour-making purposes. Millers claim that they cannot use more than about 10 per cent. of English wheat for their grist, and English wheat, largely owing to its restricted use for flour-making purposes, was being sold at some 8s. per quarter less than Canadian wheat. English wheat had to be sold on the basis of its relative value compared with foreign wheat at the ports, less the freight to these ports, while bran and other milling offals probably cost the British farmer as much as the prices paid Danish farmers, the steamer freight from the British ports to Denmark being probably no more than the railroad freights of the country places in Great Britain where bran and milling offals are consumed.

On his own land he grew wheat and sold direct to millers, whereas barley and oats were used almost entirely on the farm for feeding purposes. He carried probably quite as large a proportion of cattle as was customary in Denmark, and he had also a fairly large stock of sheep and pigs, usually about 1,000 head of live stock all told. With regard to the production of other crops, he usually obtained a yield of 9 tons per acre of potatoes, 36 to 40 bushels of wheat and barley per acre, and of roots about 30 tons per acre.

There would probably be some advantage to English farmers in growing sugar beet, but this industry would take time to develop, and in the meantime farmers were certainly passing through very bad times. The landowners, in his view, had done their best to develop agriculture, and had supplied buildings and other necessary improvements, involving a heavy capital expenditure. As shown by Mr. Thompson, the equipment of a farm with buildings, stock, and working capital involved a large expenditure, in Denmark apparently about £50 an acre—a large figure, but probably not much out of line with expenditure which would be necessary in this country for similar purposes.

He asked Mr. Thompson who was responsible for the standard of hundredweights on p. 219 of his paper dealing with the production of cereal crops. Hundredweights had no relation to market quotations. It took $4\frac{1}{2}$ cwts. of wheat to make a quarter, and cereals were quoted generally by the quarter and bushel. In Australia the statistics of yield were frequently expressed in tons, but the bushel remained as a more general standard, and he did not understand why it should be mixed up with hundredweights.

It was necessary to remember that the 1924 and 1925 harvest weather was bad, and that weather conditions in this country during harvest were usually a serious problem. Wheat in other countries was usually harvested under more favourable weather conditions, which resulted in the importation of foreign wheat being an added handicap with which British farmers had to compete.

He would like to make one broad statement in connection with what had been said about British farmers. The British farmer attended to his business about as well as anybody could do, but he was confronted with many difficulties. When one remembered what agricultural wages were in 1913, and realized that they were now double what they were then, it would be manifest that the cost of production had been very greatly increased, whereas it could not be maintained that agricultural products were fetching proportionately higher prices than before the war.

The cost of labour was admittedly 100 per cent. higher, and it could not be claimed that farmers were obtaining more than 50 per cent. to 60 per cent. more for their productions than they did before the war. This proved pretty conclusively why the farming industry was in such an unhappy condition.

Sir Robert supported the motion of thanks accorded to Mr. Thompson for his most interesting address.

Sir THOMAS MIDDLETON said he was glad to have an opportunity of thanking Mr. Thompson for the most interesting paper he had read to the Society. He must first refer to a remark made by Sir Henry Rew, and would reassure him on the question of calories. It would not be possible to class the vitamine with the calories in measuring food vales. The calorie was a definite unit; what a vitamine was no one could say. At the time when Mr. Faber read

his paper to the Society he (the speaker) pointed out that, estimated on a calorie basis, the output of Denmark was about 40 per cent. greater than the output of Great Britain. Mr. Thompson, using the pound sterling, a more familiar unit, found Danish output to be over 50 per cent. greater than British. Mr. Thompson had further pointed out that the relation of labour per 100 acres in the two countries was 40:59; thus the labour given per 100 acres of Danish land was 42 per cent. greater than on British land.

The three figures calorie value, money value, and labour expenditure were fairly comparable, and, if there were time to discuss the matter at length, he would have been able to bring his own estimate and Mr. Thompson's figures into even closer relationship.

Mr. Thompson's figures were made still more striking if the table in which he had pointed out the value of 100 acres of British land were divided up between crops and stock (p. 226). The total net value per 100 acres in Great Britain was given as £612, and the net value per 100 acres in Denmark as £954. If the totals were analysed it would be found that the British output was composed of 27 per cent. crop and 73 per cent. stock, whereas Danish output was made up of 11 per cent. crop and 89 per cent. stock. British farmers were not accustomed to regard arable land as stock land. Britain was farmed mainly for stock production, and for this purpose grass was held to be essential. In Denmark, stock and arable land were farmed together.

He would like to give a word of caution. Mr. Thompson had made reference to certain Eastern counties in which tillage was high and stock low. The returns were taken in June, and the live-stock figure of June 4 in no way represented the stock carrying of Norfolk land.

Lord Bledisloe had answered the question asked by Sir Henry Rew: What was the reason why Denmark produced 50 per cent. more output and tilled much more land than Great Britain? Sir Thomas agreed with Mr. Thompson in thinking that the size of the holding and the psychological effect of ownership had something to do with it, but these explanations did not carry one far; the real difference was in the climate. He had recently examined the climatological figures for Copenhagen—which he thought fairly represented Denmark—and compared them with British figures. If the Danish climate were compared with that of the eastern counties, the driest district in Great Britain, it would be found that both the temperature and rainfall of Denmark were lower in winter and spring, but rather higher in summer.

If the climate of Denmark, as indicated by a fairly close analysis of the monthly figures, was considered, and an examination then made of the way Denmark was farmed in 1871, the conclusion must be reached that Denmark was very badly farmed at that time. Forty-two per cent. of the land was under corn, 5 per cent. under rotation grass, and 11 per cent. under fallow crops, while no less than 41 per cent. was in permanent pasture.

For such a climate as that of Denmark this was far too much permanent grass, too little rotation grass, and much too low a proportion of roots. It was impossible for land under such conditions to be productive. About that period certain representative Danes came over to some of the eastern districts of Britain and carefully studied British methods of farming under a similar climate to their own. They went home and closely copied the system of cropping followed in some parts of our east coast.

In a district in the east of Scotland, free from mountains, for which statistics were available, and of which the climate was similar to that of Denmark, he found the following figures for cropping (in 1913): Permanent grass, 6 per cent.; arable land, 94 per cent.; corn, 34 per cent.; rotation grass, 42 per cent.; and roots, 18 per cent. The main differences between that district and Denmark (in 1919) were that Denmark had more corn, a good deal less rotation grass, and rather more roots. On the whole the arrangement of the tillage land was similar.

If one compared the output per 100 acres of Denmark with this district of Great Britain, however, the Danish output was found to be distinctly higher, although the output per man appeared to be very similar in both cases. There was a noteworthy difference between the Scottish district and Denmark as regards live stock. In Scotland, sheep and cattle formed the basis of live-stock farming.

When the Danish position in 1871 is considered in relation to the present high development, it will be seen that the Danes first started to improve their land by adopting a rotation quite similar to that farmed in Scotland. The obvious class of live stock for Denmark was the cow, not the fattening cattle and sheep of the east of Scotland. Then came a Scandinavian invention that did much for Denmark—the cream separator. Skim milk from the separator made the large pig industry possible. These technical improvements, fostered by education and personal industry, explained the success of Danish farming.

In his paper Mr. Thompson had made much of co-operation. He thought Mr. Thompson was right; co-operation was an absolute necessity for a community adopting Danish farming methods and catering for a foreign market.

Mr. Thompson referred to the Danish farmer being content with the small profit of £1 to 30s. per acre. Sir Thomas thought 99 per cent. of our British farmers would be thankful to see this profit on the average of years.

In conclusion, he had much pleasure in supporting the motion of thanks for the most interesting and valuable paper.

Dr. RUSTON said he would like to ask Mr. Thompson a question. In the table on p. 226, where the output per 100 acres of Great Britain and Denmark was compared, no indication was given as to the year.

Mr. THOMPSON replied that the table referred to the year 1922.

Dr. RUSTON also asked why Mr. Thompson took for his output only the amounts that had actually been sold. Dr. Ruston had the records for the last four years of an increasing number of farms for which he had tried to get out the gross output, and he would like to put his figures into comparable terms with Mr. Thompson's. The following were the differences between the figures at present. He had taken the initial valuation, plus purchase, and subtracted from the sales, plus final valuation; in other words, he had allowed for building-up of stock upon the farm, whereas Mr. Thompson assumed that the stock on the farm at the beginning and end of each year were identical. If those figures were taken it might be of interest to know that during the last four years, of the 60 to 80 farms whose records he had in Yorkshire, the average gross output per 100 acres was £812.

Mr. Thompson had referred to the fact that this output might be different in size and form; it would be found that the output per 100 acres did increase as the farms grew smaller. Secondly, there was a big difference between the output from arable land and grass land.

In the year 1923, when there were exceedingly low prices for corn and potatoes, the average output was £732, on the grass farms, £452, and on the arable farms, £926. This showed that the output per 100 acres on the grass farms was less than half what it was on the arable farms. For 1924-5 the average was about £870, but he had 22 cases where the gross output per 100 acres had been over £1,500, and 2 where the gross output had been over £2,000.

Mr. R. B. FORRESTER said he wished to make one or two points before the meeting closed. The first was that he rather felt that Mr. Thompson's paper was in the nature of a pioneer paper; it was not saying the same things over again. It was quite true that the previous comparisons with British farming and that of other countries had emphasized productivity, but the essential point about the paper under discussion was that it was a comparison of commercial results and that it presented a different point of view from previous comparisons that had been made. He did not suggest that the previous comparisons were not of great value, but their point of view was entirely different. Mr. Thompson was entitled to great credit because he had ventured into a field where no agricultural writers had ventured before; he had taken one step forward and tried to express the comparison in costs.

It would be very interesting to see how the actual comparison was going to work out. If he were a member of the British farming community he would not feel very comfortable about the paper. Mr. Thompson had shown on certain figures that in the two countries, of the two factors of production—land and labour—there was no very great difference in cost in the case of the land factor and in the case of the labour factor, and yet, after taking into account rates of wages and rents of land, the position remained that in Danish

farming labour and capital could be applied to an extent about 50 per cent. greater than in Great Britain.

Did it not come to this : that the present state of British farming was such - if the comparison was at all fair - that British farming would pay almost as well as it did now if it were more intensive in its application of labour and capital ? In his book on food production Sir Thomas Middleton made this point, and suggested that it was the risks involved that were holding back the farming community from putting more labour and capital into the land. It seemed as though the difference lay in organization, marketing and transport, and as though the lessening in cost of production which Denmark must have obtained must have come from those factors which were to some extent under the control of the British farming community themselves, and it seemed to him that this pioneer work ought to be of value to those who directed the policy of the British farming community.

It was one thing to say that British farming was low in its productivity, because there was always the answer that it was low because the farmer was farming commercially. Mr. Thompson now said that this did not seem to be an adequate answer. For this reason the paper seemed to strike a new note in international comparisons which was of very great interest indeed.

Mr. W. BURGESS wished to bring into prominence some points that had only been referred to by previous speakers. Mr. Forrester had referred to the pioneer nature of Mr. Thompson's work ; he surely had not forgotten that Sir H. Rider Haggard had long ago made the commercial comparison.

Sir Thomas Middleton spoke about the co-operative attitude, and rightly so, as that was the correct answer to the conundrum put by Mr. Thompson and Sir Henry Rew.

Lord Bledisloe, who so ably conducted the section of British Agriculture at the British Association Meetings, at Edinburgh and Hull, was capable of putting the point far more brilliantly than the present speaker. Lord Bledisloe was an excellent politician, and knew the whole issue was a political issue and must not be put too bluntly or too crudely.

Mr. Burgess took it that they were seeking after truth, whether for interest, utility or amusement, and therefore the facts should be faced and plainly stated.

Sir Robert Balfour had touched the spot when he spoke of the difference between the price that he could get for his products and the price that was obtained in the market. Sir Rider Haggard saw that point and emphasized it in his book. The Danish farmer had not only gone in for intensive methods, but in practice he had abolished the middleman. It was to the interest of the Danish middleman to get high prices, not only for himself, but for the circle of farmers that formed his society, instead of, as here, the cheapest possible price for the farmer and the dearest possible price for himself. The crux of the matter was that the middleman was part and parcel

of the Danish Farmers' Society, and if he made a low price he suffered with the rest. It was here that the economic factor came in, and if the system were introduced into England it would mean a political upheaval. Moreover, the co-operative system meant that the middleman was not paid in money, but in kind. For these reasons the Danish system held the field and stood almost impregnable.

Sir ROBERT BALFOUR said that the last speaker had referred to the question of the middleman in connection with the distribution and sale of agricultural products. He did not at all agree that co-operation would facilitate or improve the position of farmers in this respect. They were quite able to attend to their own affairs.

Dr. GREENWOOD, who had now replaced the President in the Chair, put the vote of thanks to the meeting, which was carried unanimously.

As the hour was getting late, Dr. Greenwood invited Mr. Thompson to reply in the *Journal* to some of the points raised in the discussion, if he felt that it was too late to deal with them at the meeting.

Mr. THOMPSON has now supplied the following comments on the discussion:—

Some of the observations made in the course of the discussion touch on points that are explained or dealt with in the course of the paper as printed, though they were not mentioned in the abbreviated version which, to save time, was read to the meeting. I propose, therefore, to limit my reply to questions which seem to need further elaboration.

Sir Henry Rew remarked that the period of 1920–4 is hardly normal. As a matter of fact the essential calculations on which the paper rests relate to the year 1922, and it is admitted and expressly stated that this year was not by any means a normal year in the case of Denmark and hardly average in the case of Great Britain. It is nevertheless evident that a later year, such as 1923 or 1924, which might more rightly claim to be "normal," would have given results much more favourable to Denmark and less favourable to this country. The selection of the year 1922 is simply due to the fact that it is the year for which certain information is available, and the use of this year does not in any way invalidate the argument, which would indeed have been much strengthened if it had been possible to take either a period just before the war or the year 1924, when conditions in Denmark were more "normal."

Another point in Sir Henry Rew's observations to which I may refer is in regard to land classed as "tillage," that is, land which in any year is actually under the plough. Land under rotation grass is excluded, but when this land is in its turn ploughed it is included as "tillage." On the whole it seems an accurate form of comparison, and it is one which has been adopted by many qualified authorities.

This remark also applies to Sir Henry Rew's inquiry as to the

basis of the "unit" of live stock, which is the assumed average relation between stock of all ages in proportion to their carcase weight. The figures relating to imported agricultural feeding stuffs cover materials either imported direct or manufactured from imported materials.

Sir Robert Balfour took some exception to figures relating to corn being given in hundredweights, rather than bushels or quarters, but I would remind him that actual weights form a more accurate basis of comparison for statistical purposes than bushels. For many years farmers have been advised to adopt measures of weight rather than capacity in their dealings, and indeed Parliament endeavoured by the Corn Sales Act to make it, if not illegal, at least unsafe to make sales in other terms than the hundredweight.

With regard to Dr. Ruston's remarks, it would no doubt be interesting to make comparisons of the results obtained by a group composed of a large number of farms, but the object of the paper was rather to draw attention to the broad differences between two countries rather than to the differences which might be found even in groups of farms comprising considerable areas. At the same time it would be of interest, and I believe of considerable value, if Dr. Ruston could compare sufficiently a large group of farms similar in type and having a high average arable area with a similar large group with a smaller arable area, with a view to testing accurately on a large scale the results of arable stock-farming on the lines practised in Denmark as compared with the more usual English methods.

In conclusion, I would point out that the first object of the paper was to draw attention to the fact that—whatever might be the reason—Denmark was in proportion to its area more productive than this country, and was able to provide employment in agriculture for a larger number of people. Speaking in broad terms, there can be no doubt that this is the case, and equally there can be no doubt that the balance is more than 50 per cent. in favour of Denmark. The second object was to find an explanation or explanations. Some of the explanations suggested, such as the adoption of co-operation and improved marketing methods, are equally within the reach of the British farmer and the Danish farmer. The fact that they have been less quickly and less freely adopted seems to be due to some more deeply rooted cause than the individualism of the British farmers. Whether the suggestion in the concluding sentence is the true one or not, the question is of sufficient importance, I suggest, to merit further consideration.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society :—

William Osborne Brigstocke.
Archibald Frederick Caddick.
Eric Roy Calvert.
Lewis H. L. Davies, B.A.
J. B. Forbes Watson.

Arthur Eric Forrest.
Evan Guest Habakkuk, M.Sc.
Frederick Horace Taylor.
John Thomas, M.A.

Corporate Representative.

D. A. W. MacKinnon, representing the Royal Mail Steam Packet Company.

SOME ADMINISTRATIVE ASPECTS OF THE RIGNANO SCHEME OF
INHERITANCE TAXATION.

By H. C. SCOTT, LL.B.

[Read before the Royal Statistical Society, February 16, 1926, the President,
Mr. G. UDNY YULE, C.B.E., F.R.S., in the Chair.]

A TENDENCY to pay much greater attention to the administrative aspects of problems of taxation is a highly commendable feature of the trend of much recent thought on Public Finance. In part this is no doubt due to the size of modern tax levies; in part, perhaps, to our recent experience of a tax which was, on most economic grounds, unquestionably a "bad" tax, which yet, in the hands of capable administrators, proved highly productive and gave rise, on the whole, to very little general complaint, as contrasted with certain other recent taxes, elegantly designed and buttressed by much perfectly correct economic theory, which yet broke down tragically in the course of administration; in part it is certainly due to the happy advent of an economic philosopher who was led to become also versed in the practical mysteries of tax-gathering. This paper is an attempt to carry the same line of thought into a well-known project of taxation, theoretically supported in many different quarters, and which has been criticized, usually, on grounds other than those of administration.

The Rignano proposals have been set forth in recent works, at considerable length, by Sir Josiah Stamp and Dr. Dalton. A modified scheme has been offered as a means for the more rapid redemption of the British National Debt, by Professor Gerbino, in the *Economic Journal*. And the scheme is briefly described elsewhere, in particular by Professor Pigou and by Mr. Findlay Shirras. My description of it can therefore be very brief, and I am able to spare myself all discussion of its merits from the point of view of theoretical economics. The idea is, that the inheritance tax should be graduated progressively according to the number of beneficial successions

through which the property has passed. Rignano has put forward two schemes :—

(1) A Maximum Project, in which the same tax as now exists is imposed on property which the deceased has himself saved, a tax of 50 per cent. is imposed on that which he inherited from the original saver, and a tax of 100 per cent. on that which he inherited from the person who took it from the original saver. Under this arrangement the whole of an estate would be absorbed by the tax after two successions.

(2) A Minimum Project, in which the rate of absorption would be slower and the estate would apparently never be completely absorbed.

In this paper I propose to study the Maximum Project only. The administrative issues are in general the same for both, and it is almost impossible, without a very extensive use of guesswork, to make any estimate of the yield of the second form of the scheme.

On the whole, I cannot help thinking that, if we admit the general atomistic outlook of modern economic thought, the project has easily justified itself, in economic theory, against such criticism as there has been of it. It does not seem to me to need any defence other than the general justification of progressive taxation, from the point of view of the distribution of the tax burden, and I cannot conceive any way in which it can militate against saving, except as a result of reactions more properly regarded, as administrative. These will be discussed in due course. In the abstract, there is indeed very little to be said against it. We pass, therefore, to the project as an actual working scheme, and ask ourselves four general questions : first, how can a value, on which the tax can be levied, be carried forward from one generation to another, in such wise that in the estate of a deceased person the portion inherited can be separated at once from the portion saved ? secondly, the problem of payment of the tax ; thirdly, the problem of evasion and its prevention ; fourthly, the yield of the scheme.

The Carrying Forward of a Value.

We can approach this matter in two different ways : we can aim only at the carrying forward of a figure—say, £25,000—which shall represent a person's estate in the estates of his heirs ; or we can aim at identifying the actual items of property, or the investments now representing them—*e.g.* certain mortgages, parcels of land, holdings of War Loan, and so on—which form the inherited as distinct from the saved wealth.

The first method is that proposed by Rignano. If, on the death of X, A takes a legacy of £50,000, then all that is necessary is for the Department to obtain periodically information as to whether A is living or dead, and on his death to deduct £50,000 from the total net value of his estate and treat this as the portion inherited and the balance as the portion saved. This possesses the merit of simplicity, and only requires an extension of existing machinery for doing the same thing in the case of limited owners on whose death a claim for duty arises under a settlement. The objections to it are three: First, it makes no provision for preventing the complete wasting of the fund; if A leaves nothing at his death there is nothing on which to levy the higher rate of tax. Secondly, it is fairly certain that in many cases personal representatives will not know what property the deceased has inherited, so that, unless the official inquiries are made at least annually, many estates will be wound up before the Department discovers that a portion was inherited, and an executor will either have to hold the capital of an estate for a considerable time, possibly several years, or the Department must be authorized to give a certificate that all duty has been paid and run the risk of losing the tax at the higher rates altogether; this point is evidently one of peculiar difficulty, in so far as the tax is made not merely a personal liability of the personal representative or the beneficiaries, but a charge on the property itself, since, without a certificate that all duty has been paid, it will be practically impossible to realize it. Thirdly, there are the problems produced by changes in the general rate of interest and in the relative values of different sorts of property. Rignano, I venture to think, treats this point rather too lightly. One may indeed quite properly look away from our immediate somewhat hectic experience in this connection. But it has to be remembered that, speaking generally, the tax will become leviable at one and two generations after the death of the original saver, and even in more stable conditions, as the general record of last century shows, the rate of interest can vary quite considerably over long periods, while the advent of a period such as that from 1914 to 1920 would completely upset the basis of assessment, if we are going to preserve even the semblance of equity, on the deaths of inheritors who die during such an episode.

Mr. A. H. Gibson, in *British Finance, 1914-21*, gives a table showing, in five-year averages, the yield of Consols since 1791. Commencing at 5.1 per cent. in the quinquennium 1795-99, the yield fell, at first somewhat rapidly, and then more slowly, to 3.1 per cent. in 1850-54, then rose again, and sank to a minimum of 2.5 per cent. in 1895-99, rising subsequently to 3.25 per cent. in

1910-14, and going to 5·2 per cent. in 1920. A simple calculation will show the wide variations which the value of a group of trustee securities would show over the whole period. And apart from the general issue of the rate of interest, there are to be considered the striking changes in *relative* prices of various standard commodities over long periods, well shown in Mr. Layton's well-known work; changes which must necessarily affect, more considerably than the rate of interest, the values of businesses and shares in companies carrying on particular lines of trade. Next, as a disturbing factor, are those transient booms in particular trades, such as oil, rubber, or tea, which for a time affect enormously the values of interests in businesses carrying on those trades; and, finally, there is the general influence of the trade cycle, again causing marked changes in business values from time to time. It is perfectly true that these variations may, as a whole, tend to compensate each other, and that the hardships they would engender could be in part mitigated by systems of index-numbers. But the point is that while index-numbers might be fair for groups, it is the individual, not the group, that is taxed, and it would be small consolation to a person who, because his grandfather died during a rubber boom and owned considerable quantities of rubber shares, finds himself called upon to pay a 50 per cent. tax on a value perhaps double the actual value of what he has inherited, to be told that this is so because it happens that there is a boom in the steel trade. It is but seldom that an individual leaves a collection of investments at all representative of the distribution of capital generally. More often than not, the bulk of his wealth is in one form of capital—land, or shipping, or coal, perhaps—and only surplus savings have gone into other forms. We should need an index-number for every distinct form of capital holding; and even then we have not succeeded in our aim, since the capital on the death of a beneficiary may be invested in an entirely different manner from the way in which it was invested on the death of the saver. The fact is that the Rignano scheme would introduce a new, and serious, business risk, and that private businesses and private companies would have to be carried on not only with an eye to general trade conditions, but also with an eye to what the valuation would be on the death of the owner; for that valuation would affect, not merely the tax to be paid on his own death, but also, in an entirely arbitrary manner, the tax to be paid on the deaths of his children. In passing, may I express the hope that, when the Rignano scheme becomes law, Parliament will either from time to time lay down the index-numbers to be adopted for valuation or, what comes perhaps to the same thing, give the Revenue authorities the power

to lay them down. I shrink from contemplating the prospect of official discussion with the public, and perhaps litigation, on the validity of the basis of an index-number.

The alternative method is that favoured by Dr. Dalton—at least it could be worked very simply on the lines of his scheme for dealing with wealth passing on death. The essence of the matter is the giving of some public authority—the Public Trustee, for instance—the legal estate in the capital of the property, so as to prevent alienation except with his consent, and then only on the condition that the proceeds were reinvested in a manner approved by him. On the death of a beneficiary, even though an absolute owner, there is no longer any difficulty in distinguishing inherited property—the Public Trustee simply accounts to the Revenue in respect of the assets in his hands.

This proposal is certainly more workmanlike. It cannot fail to appeal to those trained in the maxim that taxation “at the source” is the sheet-anchor of an effective direct tax. Nevertheless, I have serious doubts as to its economic soundness, for, in the first place, it would tend to immobilize large quantities of capital. For his own security the Public Trustee would be compelled to aim at getting as much as possible of the vast quantity of capital passing into his control into “safe” investments. He would most certainly do what Dr. Dalton suggests, *i.e.* realize interests in private businesses and private companies and get the proceeds into War Loan and railway debentures. It has been suggested by high authorities that the flow of capital into “safe” investments is already too great. Yet such an arrangement would intensify that flow. Secondly, it would tend to sterilize the economic activity of beneficiaries. However able they were—and sometimes the children of successful men are themselves able—they would be barred from using their inherited wealth in adventurous enterprises, and their activities would be correspondingly restricted, or they would degenerate, even more than at present, into mere rent- and dividend-receivers. They have, it is true, an increased incentive to save for their own children. But surely it is those with precarious incomes, not those with fixed and secure incomes, who do most saving! We want all the adventure, all the risk-taking—if it is intelligent risk-taking—that we can get, and a scheme which hinders this seems open to grave doubts on that ground alone.

The Problem of Payment.

At present the British death duties are paid almost entirely in cash, usually in one sum, but sometimes, in the case of real estate,

by instalments spread over eight years. A small amount is paid in Government securities issued after the war, where the market value is still below the value at which the security is accepted for duty. And there is an entirely neglected provision for payment by means of the transfer of land, at the option of the authorities.

The essence of the scheme before us is Payment in Kind. As described both by Professor Rignano and by Dr. Dalton, the idea is to bring about not merely the reduction, by cancellation of the securities, of national and municipal debts, but the acquiring by public authorities of interests in land and in industrial enterprises. On this matter it is evident that much of what was debated during the capital levy controversy is relevant, although the problem is obviously simpler, since only a small section of the community is making payments at any one time.

Payment in cash or War Loan is not, I think, impossible if it is assumed that the new tax scheme is to take the place of existing taxes. Something like £350 millions a year are now paid in cash, for income tax and death duties. Nevertheless it is evident that in many cases which would arise payment in cash in any reasonably short period would be a cause of grave embarrassment. And since Payment in Kind is a definite part of the scheme, we may usefully devote some attention to it.

Payment by the offering, for cancellation, of Government securities seems entirely unexceptionable, but does not seem to have any particular advantages over payment in cash, especially as any actual scheme would probably, for psychological reasons, if for no other, have to give some slight advantage or discount for payment in securities of this sort. It is evident that a considerable amount of book-keeping is involved in security payment, which can be largely avoided in cash payment. And in one respect there does seem to be a definite, although minor disadvantage, so far as general public finance is concerned. A Government which runs an ordinary sinking fund, formed out of general taxation, can redeem that part of its debt which it is for the time being of greatest advantage to redeem; but a Government compelled by law to cancel securities offered in payment of this tax would, on the whole, be redeeming securities which it was, for the time being, of greatest advantage to the investor to redeem. There could, of course, be provision for the authorities to sell any securities tendered. But in that case much of the sentimental backing for the scheme, as a strong and ruthless measure of debt redemption, would be lost, and common sense seems to indicate that from the point of view of simplicity of collection it would be better to leave the public

to do the selling and pay the brokerage charges. Personally, I am inclined to think that there would be very little payment in State securities, unless some really substantial advantage was given, as was done in the case of Victory Bonds. Government securities are too desirable an investment for trust funds of one sort and another.

Much more ambitious is the project of "progressive nationalization" by the receipt, in payment of the tax, of shares in companies, in land, in private businesses, and so forth. I think it is not unfair to say that Professor Rignano makes this the very kernel of his scheme. Something approaching general nationalization he seems to regard as inevitable, as the proletariat gains in political consciousness, and he offers this scheme as an alternative, on the one hand, to the loading of the State with debt which is involved in State purchase, and, on the other, to the forcible and catastrophic expropriation characteristic of revolutions, of which he evidently has a very thorough dislike. It is naturally no part of my subject to treat of the merits and demerits, the inevitability or otherwise, of the nationalization of industries. All I am concerned to consider is what sort of things the shareholding State would become shareholder in, and how, on general lines, the arrangement would probably work.

In the first place, the authorities must obviously be given the right to reject any asset offered, otherwise the State would become owner, or part-owner, of the weirdest collection of doubtful investments one can imagine. On the other hand, it seems only just to the taxpayer to leave him to choose what assets he will offer in payment, or to pay in cash if he can. These two considerations alone would probably stultify the whole thing; for, on the one hand, the authorities would, in the interests of the revenue, be bound to reject, as far as possible, everything of a really speculative nature, or which involved peculiar trade or market knowledge in its management, and, on the other, while no doubt the taxpayer would not mind paying in railway debentures or similar things which are, broadly speaking, the equivalent of cash, it is certain that he would strain every nerve to avoid having to transfer to the State any interests in private businesses or private companies. And here again there would result a weighting of the scales against adventurous investment. The individual approaching old age would not merely have to consider the general financial position of his family on his death, but would also have to get as much of his capital as possible into forms which would preserve his family business interests from being invaded by a very unwanted partner. There would probably be a big extension of insurance, which would perhaps lead to more

saving, but the saving would go into "safe" lines of investment, for even an insurance company, we are usually told, prefers safe and easily realizable investments to investments of the more enterprising sort. And, in general, the flow of capital into risky uses would be checked, just in the case of those people from whom in the past the flow of capital into these uses has mainly come.

However, supposing that the system of payment in kind did actually work—and there would be a good deal of payment in kind in any case, whether it was permitted or not, wherever a person died leaving property entirely, or in great part, inherited, at the second remove—and the 100 per cent. rate came into operation. What a nondescript collection of assets the State would accumulate, apart from those things such as War Loan or railway debentures, which are equivalent to cash: odd pieces of land here and there, odd little holdings in all sorts and kinds of companies, partnership interests, small private businesses, collections of furniture, any and everything which can be the object of property rights, and but seldom enough of anything to be worth retaining. Most of it would be sold for what it would fetch, and one can hardly suppose that the results which usually follow nowadays when the State tries to sell goods in bulk would not be the regular experience under the scheme. At present the State gets the benefit of a private individual's desire to get as much as possible for a thing, and can even insist on payment of duty on a value in excess of the sale price if it appears that the property was not sold to the best advantage.* The conditions of forced sale under which most of the assets which the State collected would be disposed of would, I venture to think, seriously affect the yield of the tax.

Moreover, wherever the State tried to hold business interests, or shares in companies, it would either have to take part actively in the management of all sorts of petty concerns, or it would have to put up with the management of the private individuals also interested. In companies of any size, the State would seldom acquire a controlling interest. It would have the power to interfere, but seldom the power to direct. It would be involved in the fortunes of mining companies on the Rand, of rubber companies in Malaya, of patent-medicine manufacturers, of the local gasworks, of shops in Oxford Street, of all sorts of things. It could not risk being the absentee shareholder characteristic of company life: for some sort of record of its stewardship would have to be rendered to Parliament annually, and members would want to know, and justly, why the Department

* *Ellesmere (Earl) v. Inl. Rev. Commrs.*, [1918] 2 K.B. 735.

did not do this and do that. And yet there would scarcely ever be achieved that sweeping control of an industry as a national unit which one visualizes as the very essence of State socialism. Whatever may be the abstract merits of nationalization, most people, who did not actively wish it to be a failure, would, I think, agree that industries, or large sections of industries, must be nationalized as a whole in such a way as to give the Government a free hand in managing and developing them. But when would such a position be achieved under the Rignano scheme ?

In connection with this question of payment, there is one point which should be mentioned, since it seems to have led to a definite under-estimation of the difficulties involved. The structure of joint-stock finance, with its system of division of interests into definite units and totals of units, and the legal erection of the company into a person independent of its shareholders, coupled with the experience of great companies such as the railway companies, whose shares pass readily from one ownership to another, and in which shareholding is never seriously associated with management, has led some people to think that because most substantial businesses are organized as companies, the acquirement of interests in them by the State is thereby immensely simplified. But the fact is that in its economic nature, although not in its legal form, the ordinary private company—and the great majority of companies are private—is much more akin to a private partnership than to such concerns as the railway companies. Their articles usually contain elaborate restrictions on the transfer of shares, which would have to be overridden by legislation to enable the scheme of payment in kind to work : and the only substantial shareholders are usually the directors. Further, a controlling interest in such a company may have a very different value per share from a holding which does not carry control. And even in the case of many public companies, such as Lever Brothers, the ordinary shares are in a few hands, or in the hands of another company altogether, the only capital distributed generally among the public being preference shares and debentures. In such cases the State might own most of the capital and yet have no say in management ; or, on the other hand, large bodies of investors might find themselves involved, willy-nilly, in a State-controlled enterprise, and if it made losses instead of profits, would most certainly claim an indemnity from the general revenue, and cause much political disturbance in the process. We need to pay much greater attention to actual structure, rather than to legal form, in expressing opinions on matters involving considerations such as these.

To get this question of payment in kind into proper focus, a table is appended showing the actual distribution of wealth, based on market values at the date of death, left by deceased persons where the scheme would apply. The figures are taken from those given in the table "Classification of All Property," in the last annual Inland Revenue Report. Earlier years cannot be shown because, in the first place, they include Irish property, and, secondly, because they reflect the great disturbance in values during the post-war trade boom.

Table showing the net value of property paying estate duty in the fiscal year 1923-4, for all estates over £5,000 net, classified according to type of property and size of estate of which it formed part.

[Extracted from 67th Rept. Commrs. of I.R. (Cmd. 2227),
Tables 10, 15, 17 and 20.]

	Estates.			Total for all estates over £5,000.
	Exceeding £5,000 and not exceeding £50,000.	Exceeding £50,000 and not exceeding £250,000.	Exceeding £250,000.	
Number of estates in each group	10,282	941	93	11,316
	Net values [£ thousands].			
Government and municipal securities	40,726	26,423	21,501	88,650
Interests in joint-stock companies	56,628	43,784	30,416	130,828
Cash, mortgages, loans, and policies of insurance	23,209	10,279	3,199	36,687
Trade assets and goodwill	7,028	3,182	1,075	11,285
Personal chattels	4,294	1,913	2,507	8,714
Land, house property, ground-rents, mines (including leasehold interests)	31,253	16,501	13,309	61,063
Other personalty, including expectant interests, income due, and unclassified items	4,701	1,409	6,086	12,196
	167,839	103,491	78,093	349,423

In this table the item "land" shows the net value of free and settled realty and settled leaseholds, but the gross value of leaseholds forming part of the deceased's free estate, the mortgages on which are not ascertainable from the Report. These, and all remaining deductions from gross value, have been thrown against the item

“cash,” out of which as much as possible of them would, in the normal course, be paid. The table shows, if we assume, as estimates, that one-half of the shares in companies and one-third of the item “land” are easily realizable, that nearly two-thirds of the property passing is of an easily realizable character, which rather encourages the view that the scheme would be, in practice, simply a method of collecting higher death duties and would effect very little in the way of direct nationalization. If the State kept these things, it would, of course, only have the income as current revenue; if it contemplated selling any substantial portion of them, it would seem more desirable to enforce payment in cash as the normal method, using the revenue so derived, if nationalization of any particular industry was contemplated, for the purchase of the private interests in that industry as a whole.

The Problem of Evasion.

By evasion is here meant “legal” evasion, *i.e.* the prevention, by transfer *inter vivos*, of property from becoming liable to the tax. The handling of illegal evasion is simply a question of the internal administrative efficiency of the Department, and while illegal evasion would necessarily be stimulated by the rigours of the scheme, it could no doubt be dealt with by methods already familiar.

It has become a commonplace among writers on inheritance taxation to show how completely the prophecies of widespread evasion, by transfer *inter vivos*, have been unfulfilled, and a feeling is, I think, generated that inheritance taxation can be squeezed a little higher and a little higher, without any great stimulus to evasion. There is no doubt much in this. Those “marginal” folk who start giving property away because the rate of Estate Duty is raised from 15 to 20 per cent. are probably few in number. But the Rignano scheme raises considerations of a different sort. A wealthy individual knows that directly his estate has passed through the Probate Court it is doomed to extinction in two generations. The pleasant idea of holding out to him the State as co-heir instead of simple tax-gatherer will, I fear, make little difference. Surely it is permissible to suggest that the very inevitability of the Rignano process will be a considerable stimulus to evasion, particularly by transfer to issue, on the part of the saver! It is suggested in the scheme that the gift should in such a case be treated as the first succession: this would involve a system of compulsory registration of gifts; and the gifts will then be camouflaged under the form of sales, taking up of interests in partnerships, and similar devices. How any type of check on this sort of thing is to be worked I cannot imagine. But

the extent to which the operation of the scheme would be evaded is necessarily a matter of pure speculation.

The Yield of the Tax.

The following is, so far as I can ascertain, the first attempt to measure the yield of the Rignano scheme. It is based on the assumption that the general conditions of value remain much as at present, and the figures are round numbers approximating to those in the above table. It is assumed that estates under £5,000 are exempt from the scheme and that the 1924 rates of duty are in force as regards the first transmission. The property passing in the first year of the scheme is in round figures £350 millions, and its yield under the rates of 1923-24 was £55 millions. Rignano proposes that one-third of this property shall be treated as inherited and subjected to the 50 per cent. rate; this gives a yield of £58 millions. The remaining two-thirds will in many cases be liable at lower rates than at present. Thus, for instance, an estate of £480,000 on which the rate in 1924 was 25 per cent., becomes, after deduction of the one-third, an estate of £320,000, on which the rate is 22 per cent., and an estate of £2,400,000, on which the rate was 40 per cent., becomes one of £1,600,000, on which the rate is 35 per cent. We may, I think, estimate an average fall, in the rate, of 3 per cent. The average rate at present, on the £350 millions, is about 16 per cent., so that the rate on two-thirds of this total, *i.e.* £235 millions, is taken to be 13 per cent., a yield of £30 millions. This, added to the £58 millions, represents the total yield in the first year, *i.e.* £88 millions, while £262 millions are thrown forward into the future, to be next taxed, as to £58 millions thereof, at 100 per cent., and, as to £204 millions, at 50 per cent. in years to come.

For the first few years the yield will remain at about this figure. Only a small part of the capital passing will be that inherited from the deceaseds of year I of the scheme, and all the rest will be "new estates" from the point of view of the scheme, and will be dealt with in a similar manner to the estates in year I, the amount to be treated as inherited having been ascertained by a census taken in year I.

Let us follow the fortunes of the capital which passed to beneficiaries in year I (£262 millions). A portion will have gone to persons of the same generation, or here and there of an older generation—wife or husband, brothers and sisters, parents, etc., of the deceased. The greater part will have been bequeathed probably to persons of the next generation—children, nephews, and nieces.

It is, I think, safe to assume that any scheme adopted would exempt property passing on the death of a surviving spouse, where inherited from the other party to the marriage—probably even if it were left to the surviving spouse absolutely. Hence, we may assume that the 50 per cent. and 100 per cent. rates would only come into operation on the deaths of parents, brothers and sisters, and more distant relations of the same generation, and issue, nephews and nieces, and more distant relations of the next generation; there would, of course, also be a small proportion left to strangers in blood, and a somewhat larger proportion left to charities, and which would not pass under the scheme again. It is assumed that these adjustments can be neglected, and that round about 20 per cent. passes to persons of the same generation and 80 per cent. to persons of the next generation, with or without intermediate interests to surviving spouses. Experience shows that the “mean survival period” of persons of the same generation as the deceased is about ten years, and we may, I think, assume that the deaths are distributed about equally over the twenty years following the deceased’s death. About £10 millions of the £58 millions will pass on these deaths, to be taxed at 100 per cent., a yield of half a million per annum; and about £40 millions of the £204 millions, to be taxed at 50 per cent., a yield of a million a year, so that the total additional yield from this source, from the capital first taxed in year I, will be £1,500,000 a year.

The mean survival period of beneficiaries of the next generation is about thirty years. It is assumed that these deaths are distributed equally over a period of thirty years around the thirtieth year after the death of the original deceaseds. The capital which passed in year I and passes again on these deaths is 80 per cent. of the whole, viz., £48 millions “inherited” and £161 millions saved. The annual yield in this case is, therefore, £1.6 millions + £2.7 millions, i.e. £4.3 millions from the sixteenth to the forty-sixth year of the scheme.

Going back to the capital passing in year I, it will be recalled that £116 millions of the £350 millions passing was treated as inherited. It is now assumed that this figure will be eliminated in thirty-nine years, at an even rate of £3 millions a year, to be replaced, of course, in each year’s total of capital passing, by some figure representing the actual wealth which has already passed during the existence of the scheme, and is now passing again as inherited wealth. It is also assumed that the exertions of the saving classes will keep the capital passing each year up to £350 millions. More than this can hardly be hoped for.

Finally, the capital treated as saved originally, and distributed once as liable at the 50 per cent. rate, has again, after deduction of the 50 per cent. duty, been distributed further on in the series of years, in each case on the assumption that it passes to persons of the next generation to the first inheritors.

By the application of these methods to each succeeding year of the first fifty years of the scheme, and the averaging of the results for successive periods of five years, in order to reduce somewhat such roughness as results from working to the nearest tenth of a million as regards duty, and the nearest million as regards capital, the following table was compiled :—

Average annual figures of capital liable to duty, and duty, for five-year periods from commencement of scheme, showing its operation for fifty years.

[£ millions.]

(1) Period.	(2) Capital treated as saved.	(3) Capital treated as inherited. Liable at		(5) Duty on saved capital.	(6) Duty on inherited capital. Levied at		(8) Total duty.
		50 per cent.	100 per cent.		50 per cent.	100 per cent.	
1	235	114	1	31	57	1	89
2	237	109	4	31	54.5	4	89.5
3	240	104	6	31	52	6	89
4	221	115	14	28	57.5	14	99.5
5	194	134	22	23	67	22	112
6	173	144	33	19	72	33	124
7	153	153	44	16	76.5	44	136.5
8	134	159	57	13	79.5	57	149.5
9	108	172	70	10	86	70	166
10	93	171	86	8	85.5	86	179.5

The weakest point in the assumptions on which these figures are made is, of course, that the capital passing for duty in any one year, whether saved or inherited, will remain at £350 millions. It must, however, be remembered that the capital passing for duty might very well not reflect a general increase in wealth if schemes of evasion developed which led to much saved wealth escaping altogether. And in any case, the maintenance of the figure seems to involve the assumption of an appreciable stimulus to saving.

The figures in col. (5) fall more rapidly than the saved capital (col. (2)) falls, because as the latter diminishes the *rate* of tax on it will also diminish.

It will be observed that a steadily increasing proportion of the

total duty is derived from duty collected at the 100 per cent. rate. This is a dangerous feature, for reasons already given, and might involve an appreciable diminution in the total yield. Further, no allowance is made for special remissions on account of quick successions, successions of infants, or other grounds; these also would operate to reduce the yield.

The table, I think, shows, on broad lines, that while the annual yield would be considerable after some thirty or forty years, no great increase would result for many years after the commencement of the scheme. This is not, of course, an argument against the scheme as part of a complete fiscal system operating over a long period, but it does rather militate against its immediate utility and political possibility.

The general line of criticism in this paper may seem to be mainly destructive. It is not, however, put forward for that reason, but rather, if anything in it is of value, to drive inquiry more into the line of administrative practicability, which is, after all, the final consideration in connection with any proposal of taxation. The planning of theoretical systems is an ingenious and delightful exercise, and may well open up undiscovered possibilities and add bountifully to the fruit which Professor Pigou has taught us to expect from the study of Economics. But when all is said the thing has to be worked by an ordinary department staffed with ordinary officials, neither better nor worse than the generality of their kind, and it may be that the thoughts which occur to them, and the possibilities they see, can help in the elucidation of the full nature and implications of a project such as that before us. An American reviewer recently expressed the wish that a prominent English writer on public finance could have spent some of his time as one of "Somerset House's young men," and when I read it, I mentally winged across the ocean a vote of thanks for the recognition involved in the wish.

Brief list of references to the Rignano scheme in recent English works :—

Dalton, H.—*The Capital Levy Explained* (1923), p. 90; *Inequality of Incomes* (1920), p. 316; *Public Finance* (1923), p. 92.

Gerbino, G.—"New Means for the More Rapid Extinction of the British National Debt," *Economic Journal*, vol. xxxv (1925), p. 233.

Pigou, A. C.—*Economics of Welfare* (1920), p. 642.

Shirras, G. Findlay.—*Public Finance* (1924), p. 293.

Stamp, Sir Josiah.—*Wealth and Taxable Capacity* (1922), p. 190 ; *Social Significance of Death Duties* (1925). The latter is an adaptation of Professor Rignano's own work, and contains also the article by Professor Gerbino cited above.

DISCUSSION ON MR. SCOTT'S PAPER.

SIR JOSIAH STAMP : I think that before we can intelligently accord our thanks to Mr. Scott, it is necessary that we should clearly realize the exact position occupied by this paper in the development of the subject.

The scheme was originally presented by Professor Rignano some years ago, and has been referred to by a number of writers, mainly from the standpoint of its relation to the philosophical theory of property and inheritance, but of late years more especially in connection with the literature of socialization and nationalization. It has also been dealt with by those who are dissatisfied with the effect of present methods of death-duty taxation, and who think that a similar assistance to the State in the total yield could be obtained by a closer study of this form of taxation in relation to human psychology. This third group would consider the matter from the point of view of improving death-duty schemes, by having much lower rates on the first bequest, and then having higher rates on the second and third bequests, but not the full-blooded proposals of Professor Rignano.

Mr. Scott has probably done right in addressing his paper to the full-blooded scheme, and has subjected it to the severest ordeal that the method would have to go through from an administrative aspect.

The subject has been approached from the point of view of its political value, by those desirous of socializing wealth, and also by those who would like to see if the existing system of taxation could be improved. Many people regard the present high rates of duty as a deterrent to saving.

I did not look at the scheme from the point of view of a full-blooded socialization ; I would prefer to look at it from the more limited standpoint. Writers have dealt with it from the theory of taxation, but nearly all of them, when they have got the practical aspects, say that these must be gone into by the administrator, and then sheer off. When I wrote the introduction to the English translation of the Rignano book, I also, at the end of my introduction, sheered off. I knew it would require a separate volume to develop this, and I was not prepared to go into it fully at that stage.

The Professor's scheme had not been introduced to English readers in the English language before. The book, as it stands, is not the best possible exposition of Rignano's own scheme ; some of

the ideas are quite foreign to us, and the scheme could have been presented more attractively, especially if it could have been rid of the extreme views involved in turning a whole estate over to the State in two generations.

I said that the most vital aspect for consideration was practicability, and I divided it under the following headings:—

- (a) Changes in the value of money, or rate of interest, where the same real fortune may show a fictitious increase or decrease for taxation purposes.
- (b) The succession of life interests.
- (c) Changes in valuations of variables, etc., such as mines, depending upon an estimate of length of life.
- (d) The impossibility of stereotyping the forms of wealth received as inheritance, and of holding to original valuations where the forms into which exchange has been made exhibit changes.
- (e) Rapid succession horizontally along the same generations, *i.e.* from brother to brother.
- (f) Government life annuities to successors.

One of the great merits of Mr. Scott's paper is that practically every line of it is brand new. It is carrying the subject into a field of which everyone else has kept clear. In this scheme we are not now flogging something that is purely academic theory. It is already occupying a prominent part in the political aspirations of at least two parties, the second of which keeps up an undiminished intellectual output despite its attenuation at the source, and is at the present time actually discussing the question of inheritance taxation along these lines.

It is therefore quite time the scheme in its practical aspect was looked at, but it may be asked if the subject is statistical. Ought it not to be dealt with by the Institute of Public Administration or by some legal body? It is impossible to go far along any line without requiring the aid of statistics. Those of you who remember the work done upon the "multiplier" by Sir Bernard Mallet and Mr. Strutt will know that the death-duty statistics are very difficult and elusive. It seems to me, then, that the subject is statistical in a high degree, and must be considered from that side first, whatever may be done by jurists and lawyers afterwards.

On the important question of changes in money values, one might go back to the analogy of the land values. We have come on a long way in the matter of index-numbers, since the occasion when there was hilarity in the House of Commons at the suggestion that the basic line would have to be subjected to index-numbers. We have learned since that something of that sort is more practical than the omission of it. Nevertheless, Mr. Scott has shown the difficulties when one comes to apply the principle of index-numbers to this scheme in practice.

The Dawes Committee Report did provide that whenever the value of gold altered by 10 per cent. there should be a revision of

the German annuity. To-day I am still not at all sure how far the House of Commons is educated up to the necessity of dealing with index-numbers and alterations in values.

The conclusion I have come to is, that probably if prices went up we should "frank" as inherited a fixed sum in sterling. Perhaps on the whole there are greater chances of this than otherwise. But if prices went down we should be forced by public opinion to legislate for them; we should have to give the option to value identical property still held by the inheritor, and if less than the old valuation of the inheritance, treat the new value as decisive. We should be forced to allow things where they could be proved. That would be all right for things kept in hand. We might go so far as to recognize that altered value where the man had sold his investments and bought something else. It would be comparatively easy to get a valuation for investments that were sold, but it might be difficult in the case of farms, mines, or things now in other people's hands. Where third parties had the figures of yield on which alone a valuation could proceed, it would lead to considerable difficulties.

In the matter of the machinery of the scheme, I think perhaps Mr. Scott is not as ingenious in his paper as he could be in his office. I take it that the most elementary line to take would be to follow each estate, and make a probate dossier for each new owner long before that owner died, not allowing any probate to be passed until the existence of a dossier had been ascertained, to see that all was in order, and that there was nothing inherited in the new estate. A rebate might even be given on all wills that in themselves dealt with the Rignano valuation. It would facilitate reference, and make perfectly clear what the position was, and people who got into the habit of so doing through their lawyers might be encouraged by a rebate. For I am thinking of this scheme from the point of view of whether it is possible to improve the present death-duty taxation by a different system of rates altogether, which will yield practically the same sum to the State.

I agree that there would be a strong counter tendency to squander in the second generation, and I do not see how this could be avoided.

With regard to the suggestion about the Public Trustee, it is fanciful to think he could hold up great masses of property and prevent them being dealt with excepting by his consent. But he could take over the whole of the property that was going to be cancelled at the second death in future or the whole of the impending tax and pay a life annuity to the inheritor equivalent to the income thereon. This is, of course, revolutionary to our present ideas, but if we are going as far as the principle of the Rignano scheme, this seems to me much more feasible than any other plan.

The probable yield is an interesting speculation and full of difficulties. In forty or fifty years practically the whole of the existing wealth would have passed into national possession under the full scheme. The amount of wealth then in individual hands would be equal to annual savings for about forty years. After that,

the yield would be about the present annual savings, and the amount of the present annual savings would eventually be the kind of annual yield the State would get.

I have much pleasure in moving a vote of thanks to Mr. Scott for his most interesting paper.

SIR EDGAR HARPER: I have very much pleasure in seconding the vote of thanks so ably moved by Sir Josiah Stamp, and I think we may fairly congratulate Mr. Scott on having produced a paper which should tell us very clearly the essence of the subject from the administrative point of view, without uttering a single sentence which would give his own personal view of the scheme. Perhaps the criticism is all the more interesting on that account.

I should also like to join Mr. Scott in the compliment he pays to Sir Josiah Stamp, but I cannot agree with him on some of the premises on which he bases that compliment. I could not subscribe to the view that Excess Profits Duty was a "bad" tax. As for the Land Value Duties, with which it is compared, they certainly were not "elegantly designed." I think it is common knowledge in the legal profession that it would be difficult to find a worse-framed measure than Part I of the Finance Act of 1910. That "perfectly correct economic theory" was intended to buttress a different thing—namely, an equal rate on all land values. Although Mr. Scott spares himself all discussion of the scheme's merits from the point of view of theoretical economics, it is impossible for this meeting to spare themselves altogether, especially those of us who, like myself, owe their knowledge of the Rignano scheme mainly, if not entirely, to Mr. Scott's paper. It rather shocks one to hear that such a scheme needs no defence (other than the general justification of progressive taxation) from the standpoint of the distribution of the tax burden. It seems to me that when we are considering such a scheme of transferring property from private individuals to the State, we must ask ourselves what will be the effect on industry, especially when industry is crying out for capital, and more capital, and when at the same time the people who could use the capital have a good deal of that which they make, and could use, taken away from them by various forms of taxation. To add to these forms of taxation without considering the effect upon industry, seems to me to be the course of a lunatic.

In reading the paper I was struck by its purely administrative aspect. The taxpayer's point of view was not considered by Mr. Scott for one moment. He regarded it as a problem to be solved by the Estate Duty Office. Far be it from me to say that, if we should elect a House of Commons to adopt this method of taxation, the Estate Duty Office could not evolve a scheme that would be workable and understandable by those who know it; but it would never evolve a scheme understandable by the body of people who would have to pay. That is one of the greatest dangers in front of our taxation problems of to-day. If we could simplify and make clear

the taxes we now levy, there would be a good deal less grumbling and litigation than there is at present. Let the taxpayer understand exactly what he has to pay, why he has to pay, and how the tax is calculated, and he will not mind paying taxes as much as he does to-day. This Rignano scheme is calculated to produce more problems than any of those already encountered; it seems to me that the administrative problems it contains should be sufficient to kill this scheme before it gets as far as the consideration of details.

One thing that seems to me peculiarly characteristic of the ill-judged nature of the scheme is Rignano's arbitrary assumption, that when dealing with the first death it should be assumed that one-third of the property that passed was inherited. Of course it may be very unfair to the State, but it is much more likely to be unfair to the inheritor, and in any case there is no basis whatever for it. That, because a man dies leaving £300,000, it is to be arbitrarily assumed that £100,000 of that amount was inherited from his father, should strike everyone as ridiculous.

There is one small point I should like to mention in connection with the second method proposed by Dr. Dalton, in which he wishes to get the benefit of any increase in the value of the inherited property when the inheritor comes to die. I should like to point out that, if that inheritor manages the investment with the same skill and care that he manages the investment of the property which he himself saves, he is just as much entitled to that increment which he has earned as he is in the case of the increment on his own savings. That seems to me to be an argument in favour of Rignano's idea of keeping the one figure throughout. At the same time, that again is ridiculous, and we are back again at the conclusion that in practice the thing is unworkable.

One argument that strikes me most forcibly is that the scheme could not possibly militate against saving: that it might be an additional incentive for a man to save because he knows that half of what he saves is to go to the State. I cannot conceive such an idea. The best answer can be given in the words of an old friend of mine a very successful man. I met him in the City at the time when all the taxes were at their highest, and I asked him what he was doing there. He said, "I will tell you. I am so afraid that anything that I may have saved will shortly be taken from me by the State, that I have just been to my bank and taken out a good thumping sum, and I am going for a cruise with my wife and daughters, and intend to give them the time of their lives." I believe that man represents a large class of human nature.

In conclusion, I would like to make a further suggestion. I have already ventured to suggest that a tax to be accepted by the taxpayer should be fairly easily understood, and should be as clear and simple as possible. I want also to suggest that you have to study fairness to the taxpayer, which so far seems to have been absent from our discussion. If the taxpayers of this country were treated as if it were the duty of the Revenue Officer to see that

he paid just what was fair, and not too much or too little, and to see that there was absolute justice between the taxpayer and the State, there would arise a spirit of confidence in the authorities which would be very valuable indeed to the yield of the Revenue. For when once confidence is established in a Government official—as I have had the benefit of experiencing—there is very little he may not do with a taxpayer who comes to him and puts all his cards on the table.

If these few words of mine could carry to the Board Room of Somerset House it would be a great pleasure to me. I have had the opportunity of mentioning these views to my colleagues in the Inland Revenue more than once, but they do not find such ready acceptance as some points of the paper have found in this audience.

I have great pleasure in seconding the vote of thanks to Mr. Scott for his interesting paper.

Mr. W. H. COATES said he would like to add his tribute to the thanks which had been paid by the proposer and seconder to Mr. Scott for bringing this scheme before the Society, and for treating it so admirably from its administrative aspect. He had deliberately left out those social and economic effects which were likely to flow from the Rignano scheme, and Mr. Coates felt that perhaps he would be going beyond the scope of the paper—although following the admirable example of Sir Edgar Harper—if he referred to them at any length.

He thought he might say generally, that the search for a simple tax was even more hopeless than the alchemist's search of old, and if one were to wait before changing a system of taxation until it were found, he trembled to think of the future progress in taxation.

As he looked at the Rignano scheme, he believed, with Sir Josiah Stamp, that if ever any steps were taken to advance it in this country, they would not be in the line of socialization of the whole of the property. It had to be remembered that not more than £400 millions or so passed each year by death, and that, on the other hand, the annual taxation bill was between seven and eight hundred millions; therefore it seemed that even if the full-blooded Rignano scheme ultimately came into force, there was ample room for the State each year to acquire the whole of the property resulting from death by means of death-duty taxation, and to apply it to meeting the everlasting burden of the debt, and thus release that equivalent amount of Income Tax which the taxpayer himself could apply to other purposes. It must also be remembered that no matter how deterrent Death Duties were to savings, they were undoubtedly less deterrent than an annual tax pressing on the national dividend like the Income Tax and Super-Tax. That fact was recognized in the last Budget by the present Chancellor, when with great skill he transferred an equal weight from his left hand to his right. He raised the Death Duties by a million, and at the same time remitted an equivalent amount of Super-Tax. He thought that this

particular advantage of death duties in connection with savings should be taken very strongly into consideration in weighing the merits and demerits of the Rignano scheme.

Another point which had not been touched upon was the great question of social justice. He was afraid he would detain the meeting far too long if he said much upon that subject, but it had been treated very fully by Professor Hobhouse in his book of that title, and those interested in the Rignano scheme might turn there to find some interesting aspects of the question.

The most serious problem in the paper concerned index-numbers, but as time went on, under the influence of thinkers and workers in an entirely different field—that of monetary economy—of whom Mr. Hawtrey was one of the most distinguished in this country, it was to be hoped that there would be a more stable monetary control and a more stable price-level, so that as experience was gained under new monetary conditions, the difficulty of instability would be smaller and more manageable.

The problem of squandering under the Rignano scheme was a difficult one, but he did think the fact was overlooked that most great accumulations of wealth were not made because of the ceaseless desire for wealth *per se*, but arose out of the sheer characteristics and ability of the individual concerned. Very often the pride of succession in wealth acquired by a man in that way would be sufficient to put a considerable brake on squandering. It might be argued that the present high rates of Death Duties on millionaire estates gave a similar impetus to squandering, but as yet these rates showed no such effects.

Mr. Scott had assumed that the Rignano scheme would only be introduced by degrees, but he himself did not think that followed at all. He regarded the Rignano scheme largely as a matter of systematic, detailed, and complete records, and he would be doing the Estate Duty Office an injustice if he suggested that records were among the things they did not keep. When Mr. Scott said, "in many cases personal representatives will not know what property the deceased has inherited, so that, unless the official enquiries are made at least annually, many estates will be wound up before the Department discovers that a portion was inherited," he thought the solution would be to require a return from executors of the names and addresses of the individuals to whom they had transmitted the wealth in the performance of their duties, and to watch those individuals. The Inland Revenue watched over the Income Tax, in the records of which one would expect to find arising, year by year, the fruits of that transmission of capital. This line of thought of course presupposed that the Inland Revenue would be armed with much greater powers than they had at present, and that the adoption of the Rignano scheme would indicate an attitude of mind in which the country was determined that while no man should pay more than his share of taxation, everyone should pay that share. One only had to read the records of cases that came

up in the Courts to know that, apparently, that was not so to-day. If the Inland Revenue were armed with greater powers it would be possible for them to keep track within the small number of cases in which it was really important, of where the inherited money was, and to watch it. Mr. Scott said there would be a tendency to camouflage gifts as sales, but sales implied the possession of an equivalent asset.

This extension of the powers of the Inland Revenue in respect of details of income had already begun in the Finance Act of 1922, where power was given to the Inland Revenue in regard to Super-Tax to require details of the income in order that the Authorities might be assured that the return made was reasonable. With that power, and other records in their possession, it would be possible to bring together and compare various facts with results which might sometimes be uncomfortable for the taxpayer.

He was a little surprised to read in the paper that, "It is but seldom that an individual leaves a collection of investments at all representative of the distribution of capital generally." This statement was saved by the word "generally," but the further words that, "more often than not, the bulk of his wealth is in one form of capital," certainly surprised him. While he did not pretend to know nearly as much about death-duty statistics as those whom Mr. Scott was no doubt able to consult, he had examined from time to time a considerable mass of statistics of income, which disclosed a great diversity of investment. He thought the general statistics of the Inland Revenue, and the classification in various categories of property passing on death, did not support the view advanced by Mr. Scott. At the same time, as respects private businesses, one might point out that in the latest estate-duty statistics the aggregate of this asset represented 3·36 per cent. of the total wealth. That item was not of the importance which some people might think.

He would dissent from the view that "the Rignano scheme would introduce a new, and serious, business risk, and that private businesses and private companies would have to be carried on not only with an eye to general trade conditions, but also with an eye to what the valuation would be on the death of the owner; for that valuation would affect, not merely the tax to be paid on his own death, but also, in an entirely arbitrary manner, the tax to be paid on the deaths of his children." He would suggest that that was the case with the Death Duties to-day, and the difference had to be found in the light in which a man regarded the interests of his descendants. Everyone had a great interest in his children, and it might be that he had a certain interest in his grandchildren; but after that, interest became extremely remote, and it was that fact which underlay and supported the Rignano scheme.

Mr. R. G. HAWTREY said that the opening of the paper reminded him of Einstein's theories of relativity. He, like Rignano, had a

maximum and a minimum theory, the one telescoping time and space together, the other explaining the law of gravitation as due to curvature in space. Rignano's maximum project seemed to have had something of that effect upon Sir Edgar Harper.

As Sir Josiah Stamp had pointed out, it was quite right on Mr. Scott to have faced the maximum administrative difficulties. But when dealing with the maximum project, it was nevertheless important to take account of the way in which these difficulties did melt away when the project was modified, and when all questions of total confiscation were eliminated from it. It was not merely that evasion became very much less. Personally, Mr. Hawtrey could have regarded evasion as one of the greatest weaknesses in the maximum project. Not only was evasion much less difficult with the minimum project, but these difficulties of index-numbers mattered so much less when there was no question of taking the whole of the property.

Referring to the maximum project, he thought the paper treated the difficulty of evasion in too summary a fashion, and that Mr. Coates also underestimated the danger of evasion, especially by collusive gifts. Professor Rignano assumed that there would be a record of all gifts. Was there to be a record of all gifts, however small? Obviously not. How was one to identify the handing over of a few hundred pounds at a time? It was all very well to say that these gifts could be traced, if of considerable amount, in the Income Tax Returns, but in fact it would be very difficult to trace transactions of that kind. He thought this was a thing that should be taken into consideration as a fundamental defect of the maximum project.

In the case of the minimum project, he supposed it was contemplated also to have a record of gifts. But if the minimum project could be restricted solely to property inherited or bequeathed it would simplify administration. In the case of gifts, there might be not merely deliberate evasion by the taxpayer, but some negligence or ignorance, which would lead to gifts materially affecting the ultimate position being omitted.

He thought that Mr. Scott had given a most admirable paper, and he had followed the discussion with great interest.

Mr. A. W. FLUX said he was tempted to say a word on two or three points, particularly by the aspect of the matter to which Mr. Hawtrey had referred in his remarks. Wherever there were passing at death actual savings made by the deceased, as well as inherited property, then the treatment of all gifts as being gifts from actual savings would be a reasonable attitude on the part of the Revenue Authorities, and it would certainly affect one's judgment as to the effect of gifts upon the Revenue. Would the Rignano system really stimulate gifts any more than the present Income Tax did if these gifts were deemed to be a part of actual savings of the late deceased, excepting in the case of those persons

whose savings were trivial and who lived on inherited property and the whole of whose property would be subject to high rates under this scheme on their death ! If those people owned a very important part of the wealth passing at their death, this consideration was important ; if not, it was a minor consideration.

Another point which had been raised was the necessity for index-numbers. Here again it seemed as if there were two problems—the one was the problem of the inheritance of money, or something afterwards turned into money, and subsequently to be treated as money, in which case it would be necessary to make an allowance for the change in the value of money ; the other was the inheritance of property which had remained intact throughout its holding. In that case the varying rates of valuation at different periods of succession arose. If a system of taxation of this kind were established, the handing over of inherited property to the Inland Revenue at the first succession in return for an annual payment during the life of the legatee might get over a large part of the difficulty.

It was true that more was known now about index-numbers than was known a generation ago, but there would have to be a good deal more trust in the various index-numbers when reconstructed before there would be a general willingness to repose entire confidence in their significance. He trembled to think of the burdens of responsibility that would rest on his successors.

There was one other point to which he wished to refer, and that was one that, strictly speaking, was outside the real topic before the meeting. It was necessary, however, to illustrate possible effects of the scheme by reference to known facts, or facts more or less definite. It might be easy to be misled as to the importance of the added sum placed at the disposal of the State, or that the State would be able to release in other taxation if it got possession of additional resources in such a manner as that suggested by the Rignano scheme. He sometimes wondered how far changes in the social structure influenced the whole stimulus to the accumulation of savings, whether the numerous family had a bearing on the rapid savings of the last generation, and whether in fact the corpus to be treated might not be undergoing an important change simply through the diminution in the average size of the family and the greater prevalence of no children at all, or children so few in number that reasonable provision could be made for them without accumulating great savings.

In thinking of the smaller accumulation of savings by the taxpayer—consideration for whom was urged by the seconder of the motion—it might well be that an important part of the taxpayers would be affected in regard to their accumulation by other motives than those contemplated in these new schemes of taxation, and the magnitude of advantage to the community by adopting this form of taxation in place of other forms might be involved in consequence.

(The vote of thanks to Mr. Scott, proposed by Sir Josiah Stamp

and seconded by Sir Edgar Harper, was put to the meeting, and carried unanimously.)

In view of the lateness of the hour, Mr. SCOTT replied only very briefly, and thanked members and visitors for their patience in following with so much attention the somewhat involved discussion. He has since sent the following reply to the various points and criticisms raised :—

“ In the first place I have to thank the proposer and seconder of the vote of thanks, and the others who have spoken, for the many kind things they have said about the paper. It is, of course, as Sir Josiah Stamp said, an attempt to carry the thread of discussion on this scheme forward from the point where those who have previously dealt with it have left off, and I must venture to claim for it such indulgence as is usually meted out to a little bit of pioneering. I agree at once with Sir Josiah, that if the scheme be watered down considerably, and if we are to regard it, so modified, as a device for raising a little more revenue from inheritance taxation and distributing the burden of that taxation on sounder economic lines, it then becomes a very different proposition, and the administrative issues slacken considerably in *intensity*, although they do not alter much in *character*. For one thing, there enters plenty of scope for compromise on such matters as changes in values, wasting assets, and so forth, and the question of evasion becomes much less pressing. Payment in kind, again, with all its complications, would presumably disappear altogether. The solid economic sense behind the Rignano idea makes its adoption in some such modified form vastly more attractive.

“ Sir Edgar Harper addressed himself principally to criticisms of taxation theory in general, and raised again the old matter of simplified taxes, to which I would venture to reply, firstly, that, in general, complication in taxation arises, not from an involved principle of levy, but from the amazing diversity of human relationships to which that principle must be applied; and, secondly, that in the case of the two great English systems of direct taxation, the complication arises mainly from the mass of concessions to taxpayers in circumstances somewhat out of the ordinary—one need only mention, in the case of the Income Tax, the family and depreciation allowances, and in the Estate Duty, the concessions for estates is slightly above a rate limit, for quick successions, and for the peculiar position of timber estates.

“ Mr. Coates doubted the correctness of my statement that it is but seldom that an estate mirrors in itself the distribution of capital generally. It is, of course, a very difficult point to express an opinion on, and no published information on the matter exists. My own view—expressed, perhaps, a little too dogmatically—was simply based on the perusal of some thousands of Inland Revenue affidavits. A sample investigation of the point, carried out on a fairly elaborate basis of trade and subjects of property, would be highly instructive, and would show how far general index-numbers might be adequate

for the equitable working of a modified form of the scheme. In such an investigation it seems most essential that private and public companies should be sharply distinguished, and public companies again should be classified according as the capital carrying control is in few or in many hands. The Revenue figures showing the value of private businesses passing for duty, and their proportion to the whole, give no measure of the value of businesses which are really in the hands of one person or a few persons.

"Mr. Hawtrey and Mr. Flux both spoke on evasion. It is a question where, I fear, any opinion can be little more than intelligent guesswork. We must live in hope of something turning up to put the death-duty accounts into the position in which pre-war Income-tax Returns were put by the advent of the E.P.D. 'pre-war standard,' *i.e.* a position such that people are very desirous of proving them to have been wrong; then we shall know.

"Someone asked me for my own 'carefully concealed' opinion on the scheme. I feared I had not concealed it enough. But, very briefly, it is that if Rignano's historical thesis is correct, then by the time the property-owning classes are sufficiently concerned to be willing to concede such a solution to their relations with the proletariat, much bigger things are likely to happen than the Rignano scheme."

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society :—

William Percy Avery.
Herbert Edwin Coates.
Robert Niven Gilchrist.
Arthur Hinchliffe.
Thomas Noel Hoblyn.
Albert J. W. Laslett.

Cecil Finer Mallett.
Ernest Myers.
Bernard Francis Shields, M.A.
Norman St. Barbe Sladen.
E. Miles Taylor.

WHOLESALE PRICES OF COMMODITIES IN 1925.

By THE EDITOR OF THE "STATIST."

(The "STATIST'S" Index-Numbers, in continuation of
Mr. A. Sauerbeck's figures.)

THE following table of index-numbers compiled to the end of 1912 by Mr. Augustus Sauerbeck and subsequently by the *Statist* shows the course of the wholesale prices of forty-five commodities during the last twenty years as compared with the standard period of eleven years, 1867-77, which in the aggregate is equivalent to the average of the twenty-five years 1853-77 (see the *Journal*, 1886, pp. 592 and 648, and 1893, pp. 220 and 247). There are added corresponding data for 1896, the year of lowest prices, and for 1873, just after the Franco-Prussian War.

Summary of Index-Numbers. Groups of Articles, 1867-77 = 100.

	Vegetable Food (Corn, &c.).	Animal Food (Meat, &c.).	Sugar, Coffee, and Tea.	Total Food.	Minerals.	Textiles.	Sundry Materials.	Total Materials.	Grand Total.	Silver.*	Wheat Harvest.†	Average Price of Consols ‡ £	Average Bank of England Rate ‡ Per cent.
1873	106	109	106	107	141	103	106	114	111	97.4	80	92½	4.750
1896	53	73	59	62	63	54	63	60	61	50.5	112	110½	2.483
1906	62	89	46	69	101	80	74	83	77	50.7	112	88½ ⁵ / ₁₀₀	4.267
'07	69	88	48	72	107	77	78	86	80	49.6	113	84½	4.925
'08	70	89	48	72	89	62	73	74	73	40.1	108	86½ ¹ / ₁₀₀	3.013
'09	71	89	50	78	86	61	76	75	74	38.9	113	83½	3.083
'10	65	96	54	74	89	73	81	81	78	40.5	102	81½ ³ / ₁₀₀	3.725
1911	70	90	61	75	93	76	81	83	80	40.4	110	79½ ¹ / ₁₀₀	3.467
'12	78	96	62	81	110	76	82	88	85	46.1	97	76½ ³ / ₁₀₀	3.776
'13	69	99	54	77	111	84	83	91	85	45.3	105	73½ ¹ / ₁₀₀	4.771
'14	75	100	58	81	99	81	87	88	85	41.6	109	72½ ¹ / ₁₀₀	4.038
'15	108	126	70	107	126	92	109	108	108	38.9	106	65½	5.000
1916	133	152	86	130	158	129	136	140	136	50.4	97	58½ ¹ / ₁₀₀	5.470
'17	177	192	113	169	172	192	174	179	175	65.8	102	54½ ¹ / ₁₀₀	5.15
'18	168	207	130	174	192	222	202	206	192	76.4	111	56½	5.0
'19	179	213	147	185	220	228	219	222	208	85.3	98	54½ ¹ / ₁₀₀	5.166
'20	227	263	198	234	295	262	244	261	251	76.1	96	47½ ¹ / ₁₀₀	6.71
1921	143	218	83	158	181	140	145	153	155	48.1	118	47½ ⁹ / ₁₀₀	6.092
'22	107	184	82	130	142	134	144	132	131	51.6	105	56½ ⁵ / ₁₀₀	3.692
'23	98	162	101	122	155	140	117	134	129	49.4	105	57½ ³ / ₁₀₀	3.496
'24	119	158	105	130	158	170	120	146	139	50.7	107	56½ ¹ / ₁₀₀	4.0
'25	118	162	89	128	154	165	119	143	136	52.5	114	56½	4.575
Average													
1904-13....	68	91	53	73	95	74	76	81	77	44.1	106	82½ ⁵ / ₁₀₀	3.733
1890-99....	61	80	63	68	71	56	66	64	66	55.8	103	103½ ¹ / ₁₀₀	2.958
'78-87....	79	95	76	84	73	71	81	76	79	82.1	97	99½ ¹ / ₁₀₀	3.264
'18-27....	109	90	151	111	128	105	106	112	111	98.0	—	—	3.692

* Silver 60.84d. (see note on p. 289) per oz., being the parity of 1 gold to 15½ silver = 100.

† Wheat harvest in U.K. to 1895: 29 bushels = 100; from 1896: 30 bushels = 100.

‡ Average price of Consols and the average Bank of England Rate of discount are actual figures, not index-numbers; Consols 3% to 1888, 2½% from 1889, 2½% from April, 1903.

Following a rise in the preceding year, the all-commodities index-number shows a moderate fall in 1925, at 136. It indicates a general level of wholesale prices 2.2 per cent. below the average in 1924 and 60 per cent. above the average in 1913. It is 45.8 per cent. below the index-number for 1920, the year of highest prices, and 123 per cent. above that for 1896, the lowest on record.

The complete series of annual index-numbers is shown below. The table records the Sauerbeck-*Statist* index-numbers from 1846 onwards, i.e. from the commencement of the calculations, together with Jevons' figures, adjusted to Mr. A. Sauerbeck's standard, for the years 1809, 1810 and 1818.

The "Statist's" annual index-numbers (in continuation of Sauerbeck's figures).

Year.	Average No.	Year.	Average No.	Year.	Average No.	Year.	Average No.	Year.	Average No.
1925	136	1908	73	1891	72	1874	102	1858	91
'24	139	'07	80	'90	72	'73	111	'57	105
'23	129	'06	77	1889	72	'72	109	'56	101
'22	131	'05	72	'88	70	'71	100	'55	101
'21	155	'04	70	'87	68	'70	96	'54	102
'20	251	'03	69	'86	69	1869	98	'53	95
1919	206	'02	69	'85	72	'68	99	'52	78
'18	192	'01	70	'84	76	'67	100	'51	75
'17	175	'00	75	'83	82	'66	102	'50	77
'16	136	1899	68	'82	84	'65	101	1849	74
'15	108	'98	64	'81	85	'64	105	'48	78
'14	85	'97	62	'80	88	'63	103	'47	95
'13	85	'96	61	1879	83	'62	101	'46	89
'12	85	'95	62	'78	87	'61	98	'18	159*
'11	80	'94	63	'77	94	'60	99	'10	171*
'10	78	'93	68	'76	95	1859	94	'09	189*
1909	74	'92	68	'75	96				

* Jevons' numbers adjusted.

At the commencement of last year wholesale prices began to fall and the downward movement continued till the end of June. The net decline over the whole six months was as great as 11.2 per cent., being the severest and most prolonged fall since 1921. In the preceding period of falling prices, February-June, 1924, the net decline was only 1.8 per cent.; prior to that period there was also a downward movement in April-July, 1923, the net fall being 6.9 per cent. Thus the fall in the first six months of last year is the heaviest since the great depression of 1920-22. In July there was a recovery of 2.4 per cent., which was maintained in August, but in September

there was a recession of 1.2 per cent., followed by one of 1.9 per cent. in October. A recovery of 2.1 per cent. in November was succeeded by a fresh decline of 1.9 per cent. in December.

Over the year as a whole prices fell by 11.7 per cent. The fall has continued into the first two months of the current year, and the end-of-February index-number is the lowest recorded since October, 1923. The heaviest fall last year was in the Foodstuffs category, which declined by 13.7 per cent. on balance. Vegetable foods contributed 16 per cent. to the fall, animal foods 8.9 per cent., and groceries 20.9 per cent. The Materials category fell by 10.4 per cent. on the year, minerals being 7.6 per cent. lower, textiles 14.7 per cent., and sundries 8.1 per cent. A record of the fluctuations in the monthly group and final index-numbers since the commencement of 1922 is afforded by the following table:—

Monthly index-numbers of Wholesale Prices of Commodities.

January, 1922–February, 1926.

	Vegetable food.	Animal food.	Sugar, tea and coffee.	Food-stuffs.	Minerals.	Textiles.	Sundry materials.	Materials.	All commodities.
1922.									
Jan.	111.5	168.8	75.2	125.0	136.4	146.8	132.5	137.9	132.5
Feb.	116.4	172.7	73.9	128.2	129.6	144.4	131.9	135.1	132.2
March	114.1	189.6	78.5	134.4	130.6	136.1	131.1	132.5	133.3
April	116.6	205.5	79.7	141.6	132.6	131.3	127.0	129.8	134.8
May	116.1	198.1	78.8	138.4	136.5	136.7	128.8	133.3	135.5
June	115.2	194.9	82.5	137.7	134.9	140.1	129.2	134.1	135.6
July	114.5	186.0	83.3	134.5	138.6	139.4	126.4	133.3	134.0
August	97.7	185.4	83.6	127.0	137.0	139.9	121.9	131.4	129.6
Sept.	95.2	176.9	81.1	122.3	139.4	139.9	121.5	132.0	127.9
October	99.3	173.8	86.2	124.0	142.1	145.3	122.1	134.8	130.1
Nov.	99.4	174.1	88.8	124.7	140.4	146.2	123.1	134.9	130.6
Dec.	97.5	180.1	87.9	125.9	140.7	143.8	116.7	131.5	129.1
1923.									
Jan. .	96.1	176.2	89.3	124.2	145.4	144.9	120.4	134.7	130.2
Feb. ...	93.2	177.2	100.7	125.7	156.0	138.0	122.7	136.4	131.9
March	92.7	172.4	111.8	126.1	161.8	135.4	123.5	137.5	132.7
April	96.4	170.7	113.7	127.4	159.2	142.3	123.2	138.8	134.0
May	96.4	165.2	115.3	125.7	157.3	141.6	120.2	136.8	132.2
June	95.5	156.0	101.7	119.0	152.2	141.8	117.5	134.3	127.9
July	100.0	154.7	96.6	119.5	149.1	131.2	114.0	128.7	124.8
August	99.5	160.2	89.7	119.8	148.3	132.8	113.6	128.8	125.0
Sept.	101.5	158.2	102.4	122.6	149.6	140.3	114.0	131.7	127.8
October	99.7	151.7	102.6	119.5	156.1	139.8	114.9	133.7	127.7
Nov.	101.0	151.8	108.0	121.2	160.3	159.8	114.3	140.7	132.4
Dec.	102.7	152.5	104.7	121.5	160.4	161.0	115.9	141.7	133.2

*Monthly index-numbers of Wholesale Prices of Commodities :
January, 1922—February, 1926—Contd.*

	Vegetable food.	Animal food.	Sugar, tea and coffee.	Food-stuffs.	Minerals.	Textiles.	Sundry materials.	Materials.	All commodities.
1924.									
Jan. ...	116·7	152·5	110·0	128·5	165·5	157·4	119·9	143·7	137·2
Feb. ...	116·4	147·1	115·9	127·6	173·7	158·2	121·8	147·0	138·8
March	112·3	145·2	108·6	123·6	167·8	163·2	121·4	146·9	137·0
April ...	115·9	151·6	105·4	126·8	160·4	164·0	119·2	144·1	136·8
May ...	119·0	157·0	90·9	127·1	155·6	167·9	117·5	143·3	136·4
June ...	120·0	157·3	95·3	128·5	154·1	163·7	118·4	142·0	136·3
July ...	120·0	155·9	95·0	128·0	157·3	174·0	118·4	146·0	138·4
August	117·9	162·7	100·0	130·6	156·5	169·2	116·4	143·4	138·0
Sept. ...	127·4	160·6	104·2	134·7	157·6	176·0	117·2	146·1	141·3
October	138·1	160·1	107·6	139·8	162·1	181·4	121·1	150·7	146·1
Nov. ...	131·9	153·8	112·1	135·8	164·0	184·0	121·9	152·4	145·5
Dec. ...	133·6	166·1	105·2	139·6	165·8	182·6	124·6	153·6	147·7
1925.									
Jan. ...	137·4	160·3	103·0	138·6	159·8	173·0	125·4	149·3	144·8
Feb. ...	129·3	165·3	98·6	136·1	158·6	172·6	123·9	148·5	143·1
March	120·4	171·2	94·8	133·7	152·6	169·1	122·3	144·8	140·1
April ...	120·5	165·4	89·8	130·6	151·9	164·1	120·7	142·5	137·5
May ...	121·3	168·8	84·9	131·1	151·8	152·3	121·5	139·1	135·7
June ...	108·0	160·1	85·4	122·5	147·8	156·6	117·1	137·5	131·2
July ...	112·0	163·9	84·6	125·4	153·9	160·1	118·3	140·8	134·3
August	116·5	164·4	85·0	127·5	152·9	159·0	116·2	139·3	134·3
Sept. ...	109·4	161·5	80·9	122·6	154·8	158·5	117·3	140·1	132·7
October	105·4	158·3	81·2	119·8	155·5	156·1	113·3	137·8	130·2
Nov.	109·1	155·8	83·5	120·9	152·5	167·6	115·8	141·6	132·9
Dec.	112·2	151·3	83·2	120·5	153·2	155·8	114·5	137·6	130·4
1926.									
Jan. ...	106·1	152·3	88·3	119·4	151·7	153·6	114·6	136·6	129·3
Feb. ...	103·6	154·6	87·0	118·8	151·5	146·0	115·3	134·5	127·9

Taking the comparison between December, 1924, and December, 1925, very few of the forty-five commodities show a rise on the twelve months. Wheat (*English Gazette*) records a slight gain, in the vegetable-food section, but all the other commodities on our list show a fall, which is especially severe in the case of barley, maize, and potatoes. In the animal-food group mutton and butter slumped heavily, but pork and bacon rose substantially. In the groceries section the heaviest fall is shown by coffee. Amongst minerals the strength of tin was an outstanding feature; the price of household coal was maintained on balance. Flax and hemp were prominent amongst the falls in the textiles section, but jute recorded a good rise; wool slumped heavily. Hides, leather, petroleum, soda crystals and nitrate of soda were features of strength in the sundries group.

The following figures show in each case the average index-numbers of all the forty-five commodities for ten years (*see* the dotted line in the diagram of the *Journal*, 1886, and also the *Journal*, 1893, p. 220). These give the best picture of the gradual movement of the *average* prices of *whole periods*, as the ordinary fluctuations are still further obliterated.

1818-1827 = 111	1894-1903 = 66	1906-1915 = 82
'28- '37 = 93	'95- '04 = 87	'07- '16 = 88
'38- '47 = 93	'96- '05 = 68	'08- '17 = 98
'48- '57 = 89	'97- '06 = 70	'09- '18 = 110
'58- '67 = 99	'98- '07 = 71	'10- '19 = 123
'68- '77 = 100	'99- '08 = 72	'11- '20 = 146
'78- '87 = 79	1900- '09 = 73	'12- '21 = 148
'88- '97 = 67	'01- '10 = 73	'13- '22 = 153
'90- '99 = 66	'02- '11 = 74	'14- '23 = 157
'91-1900 = 66	'03- '12 = 76	'15- '24 = 162
'92- '01 = 66	'04- '13 = 77	'16- '25 = 165
'93- '02 = 66	'05- '14 = 79	

The decade 1890-99 was the lowest on record, more closely calculated, and since then the average has advanced from 66 to 165 or by 150 per cent.

Review of the Year.—The most notable event to be recorded is the return to an effective gold standard by Great Britain, as from April 29. This action was taken in concert with Holland, Australia, and Netherlands India. South Africa followed on May 18. Sweden had already been operating an effective gold standard, and, for practical purposes, Switzerland may be placed in the same category. Other countries adhering to the gold standard, or gold-exchange standard, include Canada, New Zealand, Argentina, Peru, Colombia, Venezuela, Uruguay, Egypt, the Straits Settlements, and Siam, besides the large number of countries that have adopted the gold-exchange standard after devaluation of their depreciated paper currencies, such as the Soviet Union, Germany, Austria, Hungary, Poland, Latvia, Lithuania, Esthonia, Finland, and Chile. The Act making effective the return to the Gold Standard in Great Britain made two important changes in the gold standard of pre-war days: (1) by confining to the Bank of England the right of taking gold bullion to the Mint to have it coined, and (2) by relieving the Bank of the necessity of paying out gold coin against notes. The year opened with the Bank of England rate at 4 per cent., to which it had been raised from 3 per cent. on July 5, 1923. On March 5 it was raised to 5 per cent. The late summer and autumn months were marked by superabundance of funds in the money market, and the Bank rate was reduced to $4\frac{1}{2}$ per cent. on August 6, and to 4 per cent. on October 1. The embargo on overseas loans was removed early in November. On

December 3 the Bank rate was raised to 5 per cent. Trade was depressed in the earlier part of the year, especially in the summer months. Towards the close of the year there was a moderate recovery.

Silver.—Despite the renewed outbreak of civil war, and the anti-foreign disturbances, China continued to absorb silver. Later in the year, however, owing to accumulation of the metal in the foreign banks at the Treaty Ports, and the great falling-off in the import trade following on the boycott of British and Japanese goods, China proved a depressing factor in the market for the white metal. The Indian demand broadened considerably in the late summer, on the prospects of a good monsoon. The European inquiry for coinage purposes was unsatisfactory. On the whole, the sterling price fell by $\frac{1}{8}d.$ on balance and by $1\frac{3}{4}d.$ on the average. The average gold price of silver, however, rose by $3\frac{1}{2}$ per cent. The range of fluctuations was very narrow, being only $2\frac{3}{4}d.$ Comparative statistics of the world's production of silver are appended :—

World's production of silver (in millions of ounces).

	United States.	Mexico.	Canada.	Australia.	Other Countries.	Total.
1901 ..	55.2	57.6	5.2	10.2	44.8	173.0
'02 ..	55.5	60.2	4.3	8.0	34.8	162.8
'03 ..	54.3	70.5	3.1	9.7	30.1	167.7
'04 ..	57.7	60.8	3.7	14.5	27.5	164.2
'05 ..	56.1	65.0	5.9	15.0	30.3	172.3
'06 ..	56.5	55.2	8.5	14.2	30.6	165.0
'07 ..	56.5	61.0	12.8	19.0	34.8	184.2
'08 ..	52.4	73.6	22.1	17.2	37.8	203.1
'09 ..	54.7	73.9	27.5	16.3	39.7	212.1
1910 ..	57.1	71.4	32.9	21.5	38.8	221.7
'11 ...	60.4	79.0	32.7	16.6	37.5	226.2
'12 ..	63.8	74.6	31.6	18.1	36.2	224.3
'13 ..	66.8	70.7	31.5	3.5	51.4	223.9
'14 ..	72.4	27.5	28.4	3.6	36.5	168.4
'15 ..	74.9	39.5	28.4	4.1	37.3	184.2
'16 ..	74.4	38.2	25.4	4.2	26.6	168.8
'17 ..	71.7	35.0	22.2	10.0	35.3	174.2
'18 ..	67.8	62.5	21.2	10.0	35.9	197.4
'19 ..	56.7	62.7	15.7	7.4	32.0	174.5
1920 ...	55.5	66.8	12.6	7.5	33.0	175.4
'21 ..	53.1	64.5	13.1	4.9	35.7	171.3
'22	56.2	81.1	18.6	11.3	46.3	213.5
'23	73.3	90.9	17.8	10.3	50.2	242.5
'24*..	65.0	91.0	20.0	12.0	60.0	248.0
'25*	66.0	91.0	19.0	10.0	55.0	241.0

* Provisional.

The prices and index-numbers were as follows (60·84d.* per standard oz., being the parity of 1 gold to 15½ silver = 100):—

	Price per oz. standard. d.	Index- number.		Price per oz. standard. d.	Index- number.
Average 1873 ...	59½	=97·4	<i>Lowest</i> Nov., 1902	21½	=35·6
„ '90-99...	34	=55·8	End Dec., 1906 ...	32½	=53·1
„ 1908-17..	27½	=44·5	„ Dec., '08 ...	23½	=38·1
„ 1893	35½	=58·6	„ Dec., '11 ...	25½	=41·2
„ '96	30½	=50·5	„ Dec., '12 ..	29	=47·7
„ 1909	23½	=38·9	„ Dec., '13 ...	26½	=43·7
„ '13	27½	=45·3	„ June, '14	26	=42·7
„ '14	25½	=41·6	„ Dec., '14	22½	=37·3
„ '15 ..	23½	=38·9	„ Dec., '15	26½	=43·1
„ '16	31½	=50·4	„ Dec., '16	36½	=58·7
„ '17 ..	40½	=65·8	„ Dec., '17 ...	43½	=70·0
„ '18 ..	47½	=76·4	„ Dec., '18 ...	48½	=77·9
„ '19	57	=85·3	„ Dec., '19 ...	77½	=98·3
„ '20	61½	=76·1	„ Dec., '20	40½	=49·2
„ '21	36½	=48·1	„ Dec., '21	34½	=49·3
„ '22	34½	=51·6	„ Dec., '22	31½	=49·6
„ '23	31½	=49·4	„ Dec., '23	33½	=49·0
„ '24	3½	=50·7	„ Dec., '24	31½	=50·4
„ '25 ..	32½	=52·5	„ Dec., '25	31½	=52·1

Gold.—The value of the estimated production in recent years has been as under. The data up to 1917 are those collected by the Director of the U.S. Mint. For years after 1917, the *Statist's*

* All the index-numbers in the table from 1916 to 1925 inclusive are calculated on the basis of the gold prices of silver instead of the sterling prices, though the latter are, of course, the actual price quotations given in the table. In arriving at the index-numbers the price of gold during 1916, 1917, and 1918 is taken as 86s. 9½d. per fine oz., derived from the "pegged" New York rate of \$4·76½ to the £. For 1919 the average price of gold is taken as 93s. 4½d., this being the parity price with the U.S. dollar, the average New York exchange in that year being \$4·429. The index-numbers for other dates are based on the quotations in the London market for exportable gold. The average price in 1920 was 112s. 11½d. per fine oz., in 1921 107s. 0½d., in 1922 93s. 4d., in 1923 90s. 3d., in 1924 93s. 8½d., and in 1925 85s. 5½d. At the end of 1919 the quotation was 109s. 8½d., at the end of 1920 116s. 1d., at the end of 1921 98s. 0d., at the end of 1922 88s. 11d., at the end of 1923 95s. 4d., and at the end of 1924 88s. 2d.

estimates are given. The figure for 1925 is subject to correction. In all cases the value is taken at about £1.25 per fine oz.

	£		£
1881-85	29,900,000	1914	90,200,000
'86-90	23,100,000	'15 ...	96,500,000
'91-95	33,500,000	'16	93,800,000
'96-1900	52,900,000	'17	86,900,000
1901-05	66,300,000	'18 ...	78,200,000
'06	82,700,000	'19	75,000,000
'07	84,900,000	'20	69,400,000
'08	91,000,000	'21	67,200,000
'09	93,300,000	'22	64,800,000
'10	93,500,000	'23	73,200,000
'11	94,900,000	'24	71,000,000
'12	95,800,000	'25* ..	70,700,000
'13	94,500,000		

* Subject to revision.

The monthly (end of month) all-commodities index-numbers since 1885, together with quarterly averages for the group and final index-numbers since 1914 inclusive, are shown in the following pages.

Monthly fluctuations of the index-numbers of 45 commodities, 1867-77=100.*

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1885	72.3	72.6	72.5	72.5	73.3	72.7	72.2	72.2	71.1	70.4	71.1	70.8	72
'86	70.0	70.5	70.1	69.2	69.1	68.7	68.8	69.1	68.9	68.8	69.8	69.5	69
'87	69.5	68.5	68.3	68.4	68.2	67.9	68.1	68.3	68.2	67.7	69.1	72.4	68
'88	70.9	70.6	69.9	69.8	68.1	67.4	69.0	70.1	71.9	72.4	72.7	73.2	70
1889	72.6	73.5	72.1	72.0	71.4	71.6	72.6	71.4	72.1	72.1	73.7	73.7	72
'90	73.2	72.7	71.5	71.2	70.8	70.5	71.2	72.8	72.2	72.9	71.2	71.1	72
'91	71.1	71.5	71.7	72.4	72.8	71.8	71.6	71.9	71.7	70.7	71.4	71.4	72
'92	70.0	70.0	69.1	68.9	68.8	67.7	67.8	67.4	66.8	67.4	68.2	67.7	68
'93	68.1	69.0	68.1	67.4	67.4	67.4	67.7	67.1	68.2	68.6	67.8	67.0	68
1894	65.8	65.0	64.3	63.8	63.1	63.1	62.6	63.0	62.7	61.7	60.8	60.1	63
'95	60.0	60.0	60.8	61.7	62.5	62.4	62.8	63.3	63.5	63.3	62.3	61.2	62
'96	61.4	61.4	60.7	60.3	60.1	59.3	59.2	59.7	61.2	62.6	62.6	62.0	61
'97	62.0	61.9	61.9	61.5	61.2	61.3	61.7	63.2	63.4	62.7	62.4	62.4	62
'98	62.8	63.4	63.0	65.5	66.4	64.7	64.3	64.0	63.9	63.6	63.9	63.8	64
1899	65.4	65.8	65.6	66.1	66.6	66.9	67.9	68.3	70.0	71.5	71.6	72.3	68
1900	74.0	75.1	75.7	75.6	75.5	75.7	76.2	76.0	75.5	74.7	73.9	73.4	75
'01	72.2	71.7	71.0	70.6	70.5	69.8	69.5	69.8	69.6	69.6	69.0	68.4	70
'02	68.8	68.9	69.2	69.7	70.9	70.4	70.0	69.5	69.3	68.8	68.6	69.1	69
'03	69.5	70.2	70.4	69.4	69.6	69.5	69.5	70.0	69.1	69.0	69.0	70.0	69
1904	70.4	70.8	70.8	70.5	69.9	69.4	69.9	70.4	70.7	71.0	71.2	70.9	70
'05	71.2	71.4	71.8	72.0	71.7	72.0	72.5	72.3	72.4	73.2	74.2	74.9	72
'06	75.2	75.0	75.7	76.5	77.0	76.9	76.4	76.7	77.5	78.5	78.6	79.7	77
'07	80.0	80.7	80.0	80.7	82.4	82.0	81.1	79.4	79.1	78.8	76.7	76.2	80
'08	76.0	74.5	74.1	73.8	73.6	72.9	73.1	72.2	72.5	72.2	72.2	72.3	73
1909	72.0	71.9	72.4	74.3	75.4	75.1	75.2	74.9	74.7	75.2	75.5	76.3	74
'10	77.1	78.1	79.1	78.5	78.2	76.9	78.1	78.2	77.6	77.2	77.8	77.9	78
'11	78.5	78.6	78.9	80.0	80.3	80.0	78.9	79.5	80.3	80.7	80.6	80.9	80
'12	81.8	82.9	84.4	85.0	85.3	85.5	86.5	85.9	86.7	85.8	85.3	86.4	85
'13	86.4	86.4	86.7	86.2	85.7	84.1	84.2	85.0	85.7	84.6	83.3	83.8	85
1914	83.5	83.8	82.8	82.3	82.3	81.2	82.4	87.9	89.3	89.8	88.8	91.6	85
'15	96.4	100.9	103.7	105.9	107.2	106.4	106.4	107.0	107.8	110.0	113.1	118.4	108
'16	123.6	127.0	130.4	134.2	135.4	131.0	130.5	134.5	134.4	141.5	150.8	154.3	136
'17	159.3	164.0	169.0	173.0	175.0	180.4	176.9	175.7	176.4	180.6	182.9	185.1	175
'18	186.2	187.3	188.0	189.8	191.1	192.3	192.9	195.9	197.1	197.8	195.3	196.0	192
1919	190.1	187.7	184.7	184.0	194.6	199.4	206.4	212.7	214.8	224.3	231.0	235.2	206
'20	245.3	260.4	261.8	266.1	260.0	255.7	254.6	253.5	248.7	239.9	223.8	207.2	251
'21	197.2	183.0	177.2	169.8	162.2	155.8	158.2	154.3	149.4	138.4	136.7	133.6	155
'22	132.5	132.2	133.3	134.8	135.5	135.6	134.0	129.6	127.9	130.1	130.6	129.1	131
'23	130.2	131.9	132.7	134.0	132.2	127.9	124.8	125.0	127.8	127.7	132.4	133.2	129
1924	137.2	138.8	137.0	136.8	136.4	136.3	138.4	138.0	141.6	146.1	145.5	147.7	139
'25	144.8	143.1	140.1	137.5	135.7	131.2	134.3	134.3	132.7	130.2	132.9	130.4	136
'26	129.3	127.9											

* The average of the twelve monthly figures of each year does not necessarily coincide with the annual figures, as the latter are calculated mostly from the average of 52 weekly quotations, while the former are based on end-of-the-month prices.

*Quarterly Movements of Prices.**
Summary of index-numbers, 1867-77 = 100.

Years.	Quar- ters.	Vegetable Food (Corn, &c.).	Animal Food (Wheat, &c.)	Sugar, Coffee, and Tea.	Total Food	Mine- rals.	Tex- tiles	Sundry Mate- rials	Total Mate- rials	Grand Total.	Silver.†
1914	I	66.6	98.7	52.0	75.3	104.4	83.1	84.1	89.3	83.4	43.7
	II	67.0	97.8	51.8	75.2	98.4	82.9	82.5	86.9	82.0	43.4
	III	80.3	102.0	61.5	84.4	96.2	82.4	87.1	88.1	88.1	39.4
	IV	90.1	100.9	63.9	88.6	97.2	77.5	97.2	91.1	90.1	37.1
'15	I	105.0	114.6	66.7	100.8	110.0	85.4	104.2	100.0	100.3	37.9
	II	107.4	129.0	72.5	108.0	121.6	88.5	107.4	105.4	106.5	42.5
	III	104.0	130.5	72.0	107.0	120.8	93.5	109.4	107.1	107.1	45.5
	IV	113.8	123.9	68.7	108.0	131.2	105.6	119.3	118.0	113.8	54.2
'16	I	125.1	137.5	78.9	119.9	150.0	118.1	131.1	132.2	127.0	43.7
	II	127.2	157.0	88.2	130.0	156.2	120.4	135.0	136.2	133.3	52.1
	III	127.9	150.4	85.9	127.4	154.1	127.8	133.5	137.3	133.1	50.4
	IV	163.1	159.8	92.2	147.0	160.1	146.2	147.0	150.3	148.8	55.2
'17	I	181.2	182.5	100.6	164.7	163.3	166.6	161.5	163.6	164.1	59.5
	II	188.8	197.8	107.0	174.9	169.0	184.4	176.8	177.1	177.3	61.1
	III	168.2	194.3	114.9	166.6	168.6	201.3	179.9	183.4	176.3	72.1
	IV	161.7	192.6	133.1	167.1	172.6	215.6	192.8	194.3	182.8	70.3
'18	I	168.2	199.6	136.2	173.0	177.9	223.2	191.3	197.5	187.1	70.2
	II	167.6	201.9	123.7	171.0	182.4	223.1	207.9	205.7	191.0	77.8
	III	174.9	206.6	123.9	175.8	191.8	228.2	207.3	209.5	195.3	79.1
	IV	177.6	229.6	126.1	185.8	184.2	218.8	205.8	204.0	196.3	78.8
'19	I	171.2	216.6	121.6	177.4	173.1	202.5	201.2	194.0	188.1	77.3
	II	169.9	206.4	126.5	175.3	189.0	210.5	214.1	206.5	192.8	81.1
	III	178.0	207.1	165.5	183.7	226.1	228.9	234.9	230.7	211.3	84.2
	IV	184.3	226.6	177.6	198.2	251.5	270.1	242.6	253.4	230.1	95.7
'20	I	211.4	234.0	207.9	219.0	289.8	298.2	267.0	282.7	255.7	96.7
	II	244.5	250.1	243.0	246.3	296.3	271.8	254.5	271.1	260.6	79.2
	III	226.7	287.2	207.6	245.0	309.4	247.3	232.2	257.7	252.3	71.5
	IV	208.2	280.4	126.4	217.7	293.0	190.0	214.2	227.7	223.6	57.6
'21	I	151.4	270.6	100.1	184.5	222.6	153.5	187.9	186.7	185.8	46.8
	II	150.3	225.2	89.2	164.8	187.9	140.1	159.0	160.9	162.6	45.5
	III	149.8	202.5	81.4	155.3	174.3	142.7	147.6	153.4	154.0	48.0
	IV	113.8	166.9	78.3	127.8	149.6	150.0	132.3	142.4	136.2	52.4
'22	I	114.0	177.0	75.9	129.2	132.2	142.4	131.8	135.2	132.7	49.7
	II	116.0	199.5	80.3	139.2	134.7	136.0	128.3	132.4	135.3	52.0
	III	102.4	182.8	82.8	127.9	138.3	139.7	123.3	132.2	130.5	53.2
	IV	98.7	176.0	87.6	124.9	141.1	145.1	120.7	133.7	129.9	50.3
23	I	94.0	175.3	100.6	125.3	154.4	139.4	122.2	136.2	131.6	50.1
	II	96.1	164.0	110.2	124.0	156.6	141.9	120.3	136.6	131.4	50.5
	III	100.3	157.7	96.2	120.6	149.0	134.8	113.9	121.7	125.9	48.2
	IV	101.1	152.0	105.1	120.7	158.9	153.5	115.0	138.7	131.1	48.8
'24	I	115.1	146.2	111.5	126.6	169.0	159.6	121.0	145.9	137.7	48.8
	II	118.3	155.3	97.2	127.5	156.7	165.2	118.4	143.1	136.5	49.9
	III	121.8	159.7	99.7	131.1	157.1	173.1	117.3	145.2	139.2	51.6
	IV	134.5	160.0	108.3	138.4	163.9	182.7	122.5	152.2	146.4	52.4
'25	I	129.0	165.6	98.8	136.1	157.0	171.6	123.9	147.5	142.7	51.6
	II	116.6	164.8	86.7	128.1	150.5	157.8	119.8	139.7	134.8	51.5
	III	112.6	163.3	83.5	125.2	153.9	159.2	117.3	140.1	133.8	53.3
	IV	108.9	155.1	82.6	120.4	153.7	159.8	114.5	139.0	131.2	53.1

* The averages of the four quarterly figures of each year do not necessarily coincide with the annual averages, as the latter are based as far as possible on average weekly prices. See also the *Journal*, 1893, p. 221; 1895, p. 144; 1901, p. 90; and 1909, p. 70.

† Silver 60.84d. per oz., being the parity of 1 gold to 15½ silver, = 100 (see note on p. 289).

Construction of the Tabular Statements.

The index-numbers here given are based on the average prices for the eleven years 1867-77. Take, for instance, the *Gazette* price of English wheat:—

		s.	d.	
Average, 1867-77....	54	6	= 100, average point.	
„ 1914	35	0	= 64, or 36 per cent. below the average point.	
„ 1925	52	2	= 96, „ 4 „ „ „ „ „	

The individual index-numbers, therefore, represent simple percentages of the average point.

The articles are grouped in six categories:—

		1867-77. Total Numbers.	Example for 1925.	
			Total Numbers.	Average.
1. Vegetable food, corn, &c. (wheat flour, barley, oats, maize, potatoes, and rice)	8 Index-nos.	800	940	118
2. Animal food (beef, mutton, pork, bacon, and butter)				
3. Sugar, coffee, and tea				
1-3. Food	19 „	1,900	2,429	128
4. Minerals (iron, copper, tin, lead, and coal)....	7 „	700	1,080	154
5. Textiles (cotton, flax, hemp, jute, wool, and silk)				
6. Sundry materials (hides, leather, tallow, oils, soda, nitrate, indigo, and timber)				
4-6. Materials	26 „	2,600	3,713	143
General average ...	45 „	4,500	6,142	136

The general average is drawn from all forty-five descriptions, which are treated as of equal value, and is the simple arithmetical mean as shown above.

Average Prices of Commodities.*

No. of Article }	0	1		2	3	4	5	6	7	8	1-8	9	10
		Wheat.			Flour.	Barley.	Oats.	Maize,§	Pota- toes*	Rice.	Vege- table Food.	Beet †	
Year.	Silver.†	English Gazette.	Ameri- can.	Town Made white(now "G.R.")	English Gazette.	English Gazette.	Ameri- can Mixed.	Good English	Rangoon Carries to Arrive.	Total.	Prime.	Mid- dling.	
	d. per oz.	s. and d. per qr.	s. and d. per qr.	per sack (280 lbs.)	s. and d. per qr.	s. and d. per qr.	s. per qr.	s. per ton	s. and d. per cwt.		d. per 8 lbs.	d. per 8 lbs.	
1873 ...	59½	58.8	63	51	40.5	25.5	30	160	9.6	—	65	56	
'96 ...	30½	26.2	29	25	22.11	14.9	15	55	6.2	—	45	34	
1910	24½	31.8	36.6	31	23.1	17.4	23½	72	7.3	—	54	48	
'11	24½ ₁₀	31.8	35	29	27.3	18.10	25½	87	8.2	—	51	45	
'12	28½ ₅	34.9	38	32	30.8	21.6	27½	86	10.1	—	56	49	
'13	27½ ₁₀	31.9	36.5	30½	27.3	19.1	23½	78	8.2	—	54	49	
'14	25½ ₁₀	35.0	40.1	33½	27.2	21.0	29½	71½	9.1	—	56½	52½	
'15 ...	23½ ₁₀	53.11	59.10	49	37.4	30.9	41½	93½	13.3	—	72½	67½	
'16 ...	31½ ₅	58.5	67.7	52½	51.7	33.5	52½	153½	16.10	—	81½	76½	
'17 ...	40½	75.9	83.3	58½	64.10	51.7	71½	186½	25.3	—	104½	101	
'18	47½	72.9	78.7	46½	59.0	49.3	78½	142½	26.2	—	103	103	
'19 ...	57	72.10	74.10	46½	75.8	52.3	78½	198½	23.10	—	108	108	
'20	61½ ₀	80.7	92.4	66	90	57.4	90½	242½	41.10	—	125	125	
'21	36½	72.9	73.9	64½	54.4	34.5	38½	198	18.5	—	115	109½	
'22	34½ ₇	47.10	52.11	45½	40.1	29.1	31½	130	14.10	—	88½	82	
'23	31½ ₁₈	42.2	47.3	39½	33.8	26.8	36	101	14.10	—	79½	74½	
'24	34	49.3	53.9	43½	46.9	27.2	39½	186	16.9	—	82½	76½	
'25	32½ ₆	52.2	62.4	50½	42.0	27.2	38½ ₁₆	154	16.0	—	80	73½	
Average													
1904-13	26½	31½	36	30	25½	18½	24½	78	7½	—	51	44½	
1890-99	34	28½	31½	27½	25½	17½	19½	72	6½	—	47	37½	
'78-87	50	40	43½	34½	31½	21	25	102	8	—	55½	46	
'67-77	58½	54½	56	46	39	26	32½	117	10	—	59	50	

Index-Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.

1873 ...	97.4	108	113	104	104	98	92	137	95	851	110	112
'96 ...	50.4	48	52	54	59	57	46	47	62	425	70	68
1910 ...	40.5	58	65	67	59	67	73	62	72	523	92	96
'11 ...	40.4	58	63	63	70	72	78	74	82	560	87	90
'12 ...	46.1	64	68	70	79	83	85	74	101	624	95	98
'13 ...	45.3	58	65	66	70	73	73	67	82	554	92	98
'14 ...	41.6	64	72	73	70	81	90	61	91	602	96	105
'15 ...	38.9	99	107	106	96	118	128	80	132	866	122	136
'16 ...	50.4	107	121	114	132	128	163	131	168	1064	138	154
'17 ...	65.8	139	149	127	166	199	221	160	252	1413	177	202
'18 ...	76.4	134	140	102	151	190	241	122	262	1342	174	207
'19 ...	85.3	134	134	102	194	201	242	170	258	1435	183	216
'20 ...	76.1	148	165	143	231	221	279	207	418	1812	212	250
'21 ...	48.1	133	132	140	139	132	118	169	184	1147	193	220
'22 ...	51.6	83	95	100	103	112	96	111	148	853	150	164
'23 ...	49.4	77	84	86	86	103	111	86	148	781	134	149
'24 ...	50.7	90	96	95	120	105	122	159	167	954	139	152
'25 ...	52.5	96	111	109	108	105	119	132	160	940	136	147

* The annual prices are the average monthly or weekly quotations, except potatoes, which are the average weekly quotations during the eight months January to April and September to December.

† Not included in the general average.

‡ Meat (9-13), by the carcass, in the London Central Meat Market.

§ La Plata from 1924.

Average Prices of Commodities—Contd.

No of Article } Year.	11	12	13	14	15	0—15	16A	16B	17	18A*	18B*	18
	Mutton.		Pork.	Bacon	Butter.	Animal Food.	Sugar.			Coffee.		
	Prime	Mid- dling.	Large and Small, average.	Water- fold.	Fine- land, fine to finest.		British West Indian Refining ||	Beet, German, 88 p. c., f.o.b.	Java, Floating Cargoes, §	Ceylon Plan- tation, Low Mid- dling †	Rio, Good.	Mean of 18A and 18B.
	d. per 8 lbs.	d. per 8 lbs.	d. per 8 lbs.	s. per cwt.	s. per cwt.	Total.	s. per cwt.	s. per cwt.	s. per cwt.	s. per cwt.	s. per cwt.	
1873 ...	71	63	54	81	123	—	22½	25	28	100	86	—
'96 .	53	39	35	50	98	—	10½	10½	12½	95	58	—
1910 ...	58	52	54	75	114	—	11	12½	13½	69	42	—
'11 ..	55	49	46	56	121	—	11½	13	14	83	58	—
'12 ...	59	54	50	69	123	—	11	12½	13½	87	66	—
'13 ...	62	56	55	77	119	—	9½	9½	10½	81	53	—
'14 ...	64	57½	49	75½	120	—	11½	12½	13½	79	45	—
'15 .	75½	69½	72	93½	141	—	14½	17½	18½	78½	43½	—
'16 ...	93½	86½	87½	109½	191	—	24½	22½	26½	77½	50	—
'17 ...	114½	109½	110½	148	216	—	31½	25½	32½	94½	58	—
'18 ...	109½	109½	128½	183	247½	—	33	26½	35½	128½	69	—
'19 ...	114	114	128	190½	252	—	38½	34½	43½	145½	114½	—
'20 ...	144½	144½	168½	239½	301	—	58	65½	74½	148	111½	—
'21 ...	130½	125½	121½	179	250	—	19½	18½	22	120½	83	—
'22 ...	125	121½	101	145½	202½	—	15	14½	15½	120½	74½	—
'23 .	114½	107½	89	113½	186	—	25½	23½	24½	117½	55	—
'24 ..	111½	103½	70	106	211	—	23½	20½	21½	152½	85½	—
'25 ..	106½	98½	84½	128½	206½	—	16½	11½	12½	153½	98½	—
Average												
1904—13	58½	51½	47½	67	113	—	10½	10½	12	75½	43½	—
1890—99	54½	41½	42½	59	100	—	11½	11½	13½	98	62	—
'78—87	64½	53	49	71	116	—	17	18	21½	78	52	—
'67—77	63	55	52	74	125	—	23	24	28½	87	64	—

Index-Numbers (or Percentages) of Prices, the Average of 1867—77 being 100.

	113	114	104	100	98	760	101	98	115	134	125
1873	113	114	104	100	98	760	101	98	115	134	125
'96	84	71	67	68	78	512	46	44	109	91	100
1910 ...	92	95	104	101	91	671	51	47	79	66	72
'11	87	89	88	89	97	627	52	49	95	91	93
'12	94	98	96	93	98	672	49	47	100	103	102
'13	99	102	105	104	95	695	40	38	93	83	88
'14	102	105	94	102	96	700	50	48	91	70	81
'15 ..	119	127	138	126	113	881	67	66	90	68	79
'16 ...	148	157	169	148	133	1,067	100	93	90	78	84
'17	182	199	212	200	173	1,345	121	115	109	91	100
'18 ..	174	199	248	247	198	1,447	127	125	148	110	129
'19 .	181	207	246	258	202	1,493	155	153	167	180	174
'20 .	230	263	324	324	241	1,844	263	262	170	174	172
'21 .	203	228	234	242	200	1,527	81	77	140	98	119
'22	199	221	194	196	162	1,286	62	54	140	116	128
'23	182	196	171	154	149	1,135	104	87	135	86	111
'24	177	188	135	143	169	1,103	93	75	175	133	154
'25 ..	169	180	162	174	165	1,133	60	43	176	154	165

Index-numbers not included in general average.

East India good middling from 1908.

† Comparative values.

White Javan, C.I.F., from 1924.

§ Raw Centrifugals, 96 per cent. Pol., from 1924.

Average Prices of Commodities—Contd.

No. of Article	19A*	19C*	19B*	19	18—19	1—19	20A	20B	21	22	—	23
Year.	Tea.				Sugar, Coffee, and Tea. Total.	Food. Total.	Iron.			Copper.		Tin.
	Congou, Com- mon.	Indian Good Medium	Average Import Price. d. and dec. per lb.	Mean of 19A and 19B.			Scottish Fig. s. and d. per ton	Cleveland (Mid- dles- brough) Fig. s. and d. per ton.	Bars, Com- mon. £ per ton.	Stand- ard. £ per ton.	English Tough Cake. £ per ton.	Straits. £ per ton.
	d. per lb	d per lb.										
1873 ..	12	—	16·67	—	—	—	117·3	—	12½	84	92	132
'96 .	4	7½	9·55	—	—	—	46·10	38·2	5	47	50	60
1910 ..	4½	7½	8·23	—	—	—	56·1	50·1	6½	57	61	155
'11	5½	8½	9·00	—	—	—	53·5	47·3	6½	56	60	191
'12	5½	8½	8·78	—	—	—	64·2	58·2	7½	73	78	210
'13	5	8½	9·06	—	—	—	65·6	58·3	7½	68	73½	201
'14	6	8½	9·19	—	—	—	57·1	51·0	7	59½	64½	151
'15 ...	8½	10½	11·01	—	—	—	71·2	65·2	10½	72½	82½	164
'16 ...	8	10½	11·29	—	—	—	90·0	84·0	13½	115½	134	182
'17 ..	16½	15½	14·68½	—	—	—	95·7	89·7	13½	124½	136½	238
'18 ...	20½	16	15·0	—	—	—	101·0	95·0	14	115½	126	331
'19 ...	13½	15	15·5	—	—	—	143·1	137·1	19½	92	99½	257
'20 ..	11½	9½	14·97	—	—	—	214·11	208·11	28½	97½	112½	302
'21 ...	4½	7	12·4	—	—	—	168·6	137·4	19½	69½	72½	171
'22	8½	13½	14·9	—	—	—	99·10	90·7	11½	83½	66½	162
'23	11	17½	17·58	—	—	—	108·0	108·9	11½	65½	69½	206
'24 ...	9½	17½	19·0	—	—	—	96·8	88·2	12½	63½	67½	251
'25	7½	14½	18·34	—	—	—	83·4	72·8	11½	61½	65½	267
Average												
1904—13	4½	7½	8½	—	—	—	57½	51½	6½	67½	72	164½
1890—99	4½	7½	9½	—	—	—	47	41½	5½	50	53	81
'78—87	6½	—	12½	—	—	—	46	38	5½	55	60	89
'67—77	11½	—	17½	—	—	—	69	60	8½	75	81	105

Index-Numbers (or Percentages) of Prices, the Average of 1867—77 being 100.

1873 ...	107	—	97	102	426	2,037	170	—	152	112	—	126
'96 ...	36	—	56	46	236	1,173	68	—	61	63	—	57
1910 ...	40	—	48	44	214	1,408	82	79	76	—	—	148
'11 ...	47	—	52	50	244	1,431	78	77	75	—	—	182
'12 ...	48	—	51	50	248	1,544	95	89	97	—	—	200
'13 ...	44	—	52	48	214	1,463	96	94	91	—	—	191
'14 ...	53	—	53	53	232	1,534	84	85	79	—	—	144
'15 ...	74	—	64	69	281	2,028	106	128	97	—	—	156
'16 ...	71	—	65	68	345	2,476	135	166	154	—	—	173
'17 ...	150	—	85	117	453	3,211	144	166	166	—	—	227
'18 ...	186	—	87	137	518	3,307	152	170	154	—	—	315
'19 ...	120	—	90	105	587	3,515	217	234	123	—	—	245
'20 ...	100	—	88	94	791	4,447	329	343	130	—	—	288
'21 ...	39	—	72	55	332	3,006	237	232	92	—	—	163
'22 ...	77	—	86	82	326	2,465	148	136	84	—	—	154
'23 ...	93	—	102	100	402	2,318	168	144	88	—	—	196
'24 ...	82	—	110	96	418	2,475	143	152	84	—	—	239
'25 ...	70	—	106	88	356	2,429	121	144	82	—	—	254

* Index-numbers not included in the general average.

† Approximate.

‡ Nominal.

Average Prices of Commodities—Contd.

No. of Article	Year.	24	25A	25B	26	20—26	27	28	29A	29B	30A	30B	31
		Lead.	Coal.			Minerals. Total.	Cotton		Flax.		Hemp.		Jute.
		English Fig.	Wallsend Hetton in London.	New- castle Steam.	Average Export Price.		Mid- dling Ameri- can.	Fair Dhollerah. ||	Petro- grad. ¶	Russian Average Import, Price.	Manila Fair Roping.	Petro- grad Clean.	
			£ per ton	£ per ton	£ and dec. per ton.		d. per lb.	d. per lb.	£ per ton	£ per ton	£ per ton	£ per ton	
1873	23½	32	—	20.90	—	9	6½	47½	44	43	36	18
'96	11½	15½	8	8.85	—	4½	3½	26	27	17½	25	12½
1910	13½	17½	10½	11.72	—	8.00	6	35	37	23	30	14½
'11	14½	17½	10½	11.43	—	7.04	6	37	43½	20	33	20½
'12	18½	21½	14½	12.70	—	6.45	5½	36½	40½	26	37	21
'13	19½	21½	15½	13.94	—	7.01	5½	34	41½	31½	38	26½
'14	19½	21½	14½	13.65	—	6.41	4½	33	38	26½	43	27½
'15	24	30½*	21½	16.96	—	5.87	4½	59½	66½	41½	60½	21½
'16	32½	27½*	41½	24.64	—	9.00	7	76½	85½	54½	71	31
'17	32½	27½*	30	27.16	—	16.55	13½	113½	151½†	84½	105½	39½
'18	32½	33.6	33½	30.6	—	22.3	17½	120½	156½	99½	160½	39½
'19	29½	45.3	45½	46.2	—	19.65	14½	120½	174½	58½	117½	50½
'20	40	32	51½	79.8	—	23.14	13½	120½	345½	65½	145½	44½
'21	24½	32½	29	34.83	—	9.4	5½	112½	118½	40½	145½	27½
'22	25½	34½	24½	24.16	—	12.10	8	95	84½	33½	57½	30½
'23	28½	32½	28	25.13	—	15.25	10	83½	84½	33½	57	26
'24	35½	27½	22½	23.38	—	16.26	11.03	120	104½	44	81	31½
'25	37½	29½	16½	20.08	—	12.64	11.01	92½	120½	46½	89½	49½
Average													
1904-13		15½	18½	11½	11½	—	6½	5	32½	36½	30½	31½	18½
1890-99		12	17½	10½	10½	—	4½	3	27	27½	26½	25	12½
'78-87		14	16½	8½	9	—	6	4½	33	34	35½	26½	15
'67-77		20½	22	12½	12½	—	9	6½	46	48	43	35	19

Index-Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.

1873	....	117	145	—	167	989	100	92	97	101	95
'96	....	56	68	—	71	444	48	46	56	55	64
1910	....	65	78	—	94	622	89	89	77	68	78
'11	....	70	81	—	91	654	78	89	86	68	107
'12	....	89	99	—	102	771	72	79	82	81	111
'13	....	93	98	—	112	775	78	84	80	89	140
'14	....	95	97	—	109	693	71	67	76	89	143
'15	....	117	140	—	136	880	65	64	134	130	111
'16	....	159	125	—	197	1,109	100	104	172	161	163
'17	....	158	125	—	217	1,203	183	201	282	243	207
'18	....	158	153	—	245	1,347	248	253	294	341	207
'19	....	143	206	—	370	1,538	218	219	313	264	264
'20	....	195	145	—	638	2,068	257	203	495	270	236
'21	....	118	147	—	279	1,268	104	86	246	237	145
'22	....	123	156	—	193	994	134	118	191	116	162
'23	....	139	147	—	201	1,083	169	148	179	116	137
'24	....	175	125	—	187	1,105	181	163	239	160	167
'25	....	183	135	—	161	1,080	140	163	227	174	261

* Approximate prices.

† Approximate.

‡ Nominal.

§ Best Yorkshire house after 1916.

|| Now No. 1 Oomra, Fine.

¶ Livonian Z.K. from 1921.

Average Prices of Commodities—Contd.

No. of Article	32A	32B	33	34	27-34	35A	35B	37	36A	36B	37
	Wool.			Silk.		Hides.			Leather.		Tallow.
Year.	Merino, Port Phillip Average fleece.	Merino, Adelaide, Average Greasy.	English, Lincoln Half Hogs.	Tsatslee. †	Textiles. Total.	River Plate, Dry.	River Plate, Salted.	Average Import Price.	Dressing Hides.	Average Import Price.	Town.
	d. per lb.	d. per lb.	d. per lb.	s. per lb.		d. per lb.	d. per lb.	d. and dec. per lb.	d. per lb.	d. per lb.	s. per cwt.
1873	25	11½	24½	21½	—	11	8½	—	18½	—	44
'96	13	6½	11½	10½	—	6½	5½	4.89	13½	13½	21
1910	18½	9½	9½	10½	—	9½	7½	7.15	16	17½	35½
'11	17½	8½	10	10½	—	9½	7½	7.17	17	17½	33½
'12	17½	9½	10½	10½	—	10½	8½	7.61	17½	17½	33
'13	18	9½	12½	11	—	12½	9½	8.62	19½	19½	34½
'14	18½	9½	12½	10½	—	13½	9½	9.11	21½	19½	31½
'15	21½	10½	17½	9½	—	13	11	10.04	28½	21½	36½
'16	32½	16½	20	16½	—	14½	13½	11.70	28½	27	46½
'17	46½	23½	20½	21½	—	20	16	15.52	35	34½	62½
'18	47½	23½	18½	25½	—	20½	13½	15.9	32½	32½	81½
'19	67	32½	22½	26	—	22½	19½	17.1	36½	40½	87½
'20	79½	32	22	38½	—	20½	18½	20.1	43½	71½	75
'21	31½	11½	8½	26½	—	9½	8½	9.58	25½	46½	36½
'22	39	17½	9½	28½	—	9½	8½	8.06	24½	30	34½
'23	43½	20½	12	24½	—	9½	8½	8.23	23½	31½	36½
'24	53½	25½	18½	23½	—	10½	8½	8.63	22½	33½	42½
'25	41½	17½	17½	18½	—	11½	8½	9.87	23	33	42½
Average 1904-13	17½	9	10½	11½	—	9½	7½	6½	16	17	31½
1890-99	13½	6½	10	11½	—	6½	5½	5	13½	13½	25
'78-87	18½	8½	11½	15	—	8½	6½	6½	15	17	35½
'67-77	21½	9½	19½	23	—	9	7	6½	16	18½	45

Index-Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.

1873 ...	118	—	124	95	822	120	—	—	114	—	97
'96 ...	62	—	58	46	435	77	—	—	84	—	77
1910	90	—	51	45	587	106	—	—	96	—	79
'11	83	—	51	47	609	106	—	—	99	—	74
'12	86	—	53	46	610	114	—	—	101	—	73
'13	88	—	63	48	670	133	—	—	112	—	76
'14	90	—	64	47	647	139	—	—	118	—	70
'15	104	—	88	43	739	149	—	—	145	—	81
'16	159	—	101	71	1,031	174	—	—	160	—	104
'17	219	—	106	94	1,535	225	—	—	200	—	139
'18	222	—	95	112	1,772	218	—	—	188	—	182
'19	315	—	114	113	1,820	258	—	—	222	—	195
'20	359	—	111	168	2,099	257	—	—	330	—	167
'21	140	—	44	115	1,117	123	—	—	205	—	81
'22	180	—	49	125	1,075	114	—	—	174	—	77
'23	206	—	61	105	1,121	113	—	—	158	—	81
'24	254	—	96	102	1,362	119	—	—	163	—	94
'25	188	—	87	79	1,319	132	—	—	161	—	94

* Port Phillip fleece washed nominal since 1895, exactly in proportion with the value of clean wool.

† Common New Style from 1921.

Average Prices of Commodities—Contd.

No. of Article } Year.	38	39	40A	40B	41	42	43	44	45A	45B	45—45	20—45	1—45
	Oil.		Seeds.		Petro- leum.*	Soda.	Nitrate of Soda.	Indigo.	Timber.		Sundry Materials.	Materials. Total.	Grand Total
	Palm.	Olive.	Lin- seed.	Lin- seed.	Refined.	Crystals.		Bengal, Good Consuming.	Hewn, Average Import Price.	Sawn or Split, Average Import Price.			
	£ per ton.	£ per ton.	£ per ton.	s. per qr.	d. per gall.	s. per ton.	s. per cwt.	s. per lb.	s. per load.	s. per load.	Total.	Total.	Total
1873	38	43	32	62	15½	100	15½	6½	65	62	—	—	—
'96	22	30	17½	33	5½	42	8	4½	40	44	—	—	—
1910	35	47	38½	66	6	61	9½	3½	36	57	—	—	—
'11	34½	50	42½	70	5½	57	10	3	38	57	—	—	—
'12	33	48	35½	60	8½	53	11½	2½	41	60	—	—	—
'13	35½	49½	24½	45½	8½	47½	11½	2½	40	63	—	—	—
'14	37½	50½	24½	48½	7½	47½	10½	5½	41½	64½	—	—	—
'15	34½	51½	30½	57½	8½	48½	12½	13½	58½	94½	—	—	—
'16	44½	59½	41½	80½	12	78½	17½	13½	82½	148½	—	—	—
'17	46	115½	56½	112½	16½	89½	25	10½	97½	210	—	—	—
'18	44½	198½	63½	131½	21½	82½	27½	9	107½	271	—	—	—
'19	69½	200½	92½	139½	17½	118½	24½	9½	137½	232½	—	—	—
'20	69½	200½	88½	157	25½	150½	24½	14½	119½	261½	—	—	—
'21	36½	80½	31½	72½	22½	140	18½	11½	68½	156½	—	—	—
'22	34½	75½	39½	75½	15½	123	14½	9½	46½	117½	—	—	—
'23	36½	66½	42½	77½	13	103	13½	7½	48	131½	—	—	—
'24	40½	79½	42½	81½	13½	101½	13½	6½	49½	122	—	—	—
'25	40½	73½	43½	80½	13½	100	13½	5½	47½	122½	—	—	—
Average													
1904-13	31½	43½	26½	49½	6½	60	10½	3	38	56	—	—	—
1890-99	24½	35	19½	38	5½	53	8½	4½	40	45	—	—	—
'78-97	32½	40	23	46	6½	62	12½	6	47	47	—	—	—
'87-77	39	50	30	60	12½*	92	14	7½	60	54	—	—	—

Index-Numbers (or Percentages) of Prices, the Average of 1867-77 being 100.

	97	86	105	122	109	110	92	111	1,163	2,974	5,011
1873	97	86	105	122	109	110	92	111	1,163	2,974	5,011
'96	56	60	56	44	46	57	59	74	690	1,569	2,742
1910	90	94	116	48	66	70	43	82	890	2,099	3,507
'11	88	100	125	43	62	71	41	83	892	2,155	3,586
'12	85	96	106	66	58	80	38	89	906	2,287	3,831
'13	90	99	78	68	52	82	38	90	918	2,363	3,826
'14	84	101	82	61	52	78	80	93	958	2,298	3,832
'15	89	104	97	71	53	90	184	134	1,197	2,816	4,844
'16	114	119	135	96	86	128	183	202	1,501	3,041	6,117
'17	118	231	187	129	98	178	142	270	1,917	4,655	7,866
'18	115	396	216	170	90	194	124	332	2,225	5,344	8,651
'19	178	400	258	138	128	177	126	325	2,405	5,763	9,278
'20	179	400	272	203	164	177	200	335	2,684	6,851	11,298
'21	95	160	116	177	152	135	158	198	1,600	3,985	6,991
'22	89	151	127	122	134	102	128	143	1,361	3,430	5,895
'23	93	133	134	104	112	96	103	157	1,284	3,488	5,806
'24	103	160	138	105	111	97	84	151	1,325	3,792	6,267
'25	104	147	137	105	100	96	79	150	1,314	3,713	6,142

* Petroleum average, 1873-77.

† Nominal.

MISCELLANEA.

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THE INFLUENCE ON THE PRECISION OF INDEX-NUMBERS OF
CORRELATION BETWEEN THE PRICES OF COMMODITIES.

By A. L. BOWLEY.

THE accuracy of index-numbers as an expression of price-changes in a defined group depends on three conditions, on which different writers lay different emphasis. The first is the relative importance assigned to commodities so that in the aggregate they shall represent faithfully the whole of the transactions in the group, illustrated in the case of the Board of Trade Index by basing it on the Census of Production. The second is the method by which the price-changes are combined, as discussed in Professor Irving Fisher's *The Making of Index-Numbers* and by other writers. The third is the inexactness that arises from the fact that in nearly all cases—a principal exception being the measurement of the price-changes of imported materials—the price-changes used are a sample of all the price-changes that exist, a condition discussed in Memorandum No. 5 of the London and Cambridge Economic Service and referred to by Professor Edgeworth in the *R.S.S. Journal* for July, 1925, pp. 559 *sqq.* It is the third condition which is here analysed, with some slight reference to the first. The example taken is the *Statist* index-number for 1913, but the method may be applied to index-numbers in general.

If the *Statist* index-number were formed by choosing completely at random the price-changes of 45 commodities from the group of all

existing commodities, and if the change of price of each commodity was independent of the change of all others, then the usual formula for the precision of an average of independent variables would apply. But in fact the selection is not random, but has at least some reference to the importance of the commodities in national economy, and the price-changes of, for example, English and American wheat, and of prime and middling beef, may be expected to be correlated. Further, in a number of cases the number used is already the average of two or more kinds of goods. We have therefore to consider the question of the determination of the number of independent commodities that is equivalent to the 45 price-changes actually averaged. There are no doubt many ways of approaching the problem, none of which can claim to be uniquely correct. We will first explain the method adopted and then consider further its implications.

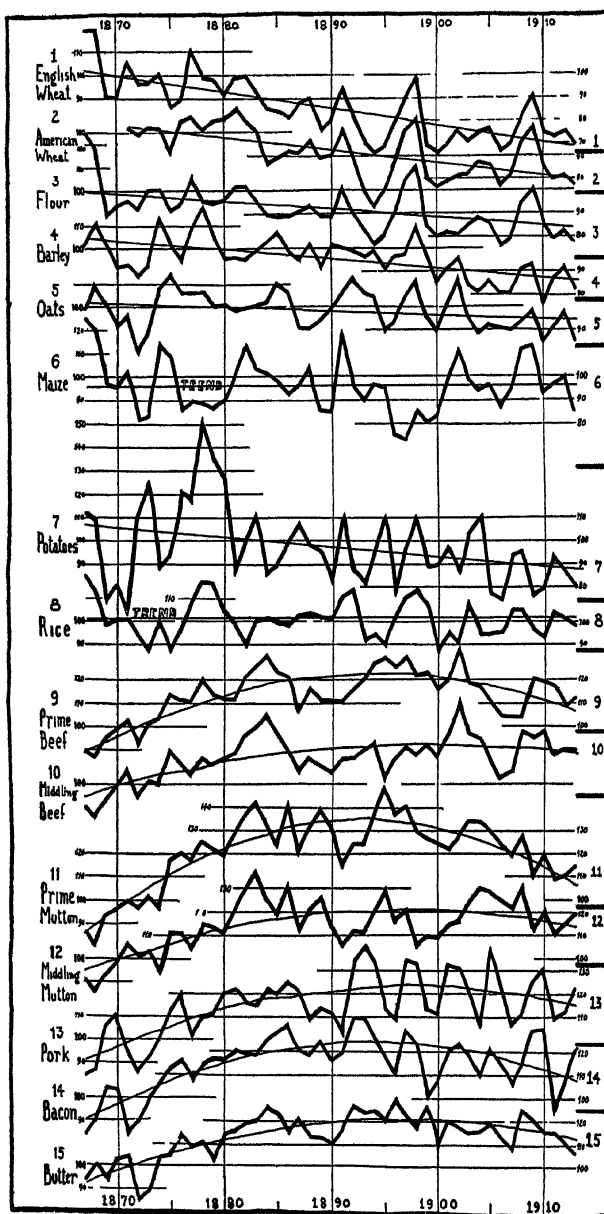
If we simply calculated the correlation coefficients between pairs of the series of the price-relatives of commodities over the period 1867-77 (Mr. Sauerbeck's base) to 1913, they would be dominated by the general fall of prices to 1895 and the subsequent rise. The first step taken was to eliminate this general movement altogether and to replace the original 45 series by 45 new series, in which each original entry, *e.g.* 69 for flour in 1908, is expressed as a percentage of the general index in each year, *e.g.* $100 \times 69 \div 73 = 94.5$, 73 being the general index for 1908. If we may assume that the series of general index-numbers represents the reciprocal of the purchasing power of the sovereign, these new series express the variation of prices of the various commodities in terms of a hypothetical unit of money whose purchasing power is constant. The resulting 45 series are shown in the diagrams.

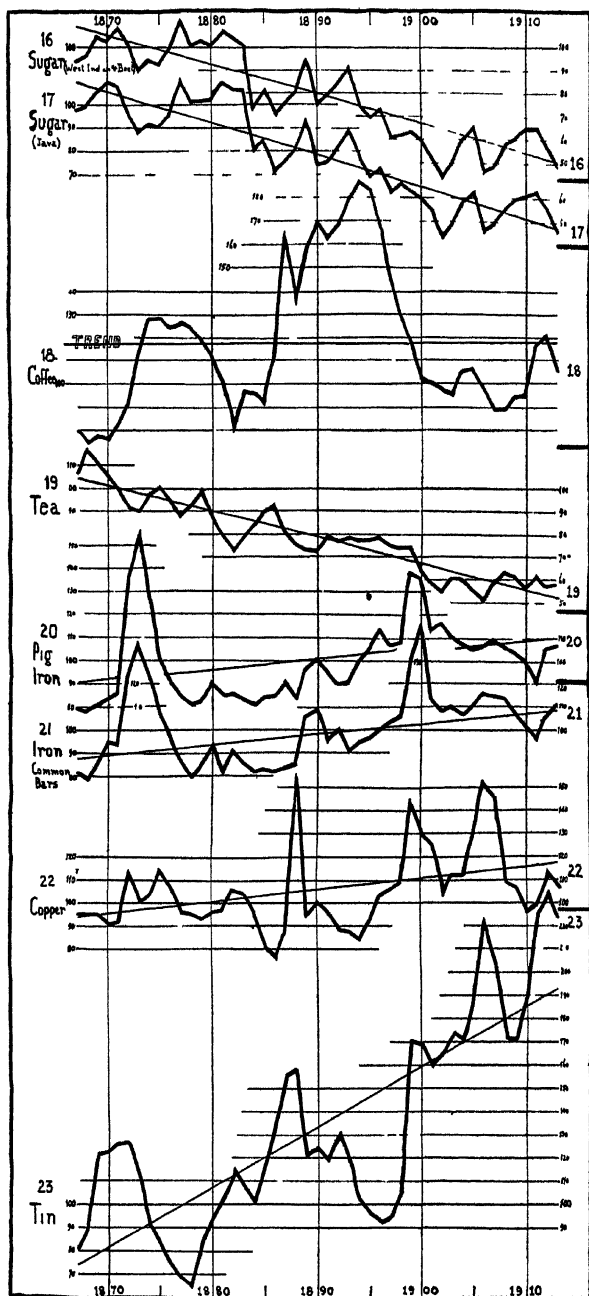
Inspection of these diagrams shows that, even after the general movement of prices is eliminated, the series by no means fluctuate at random about their original level. There are definite trends—in Mr. Yule's phrase, "serial correlations"; the grains fall away, the metals rise, and so on. The second step is to separate the trend from the fluctuations, by a method which, though it is not essentially novel, is best set out in detail. Each series is regarded as a polynomial with the time as variable, containing as many terms as have significant coefficients, together with a residual which is independent of the time.

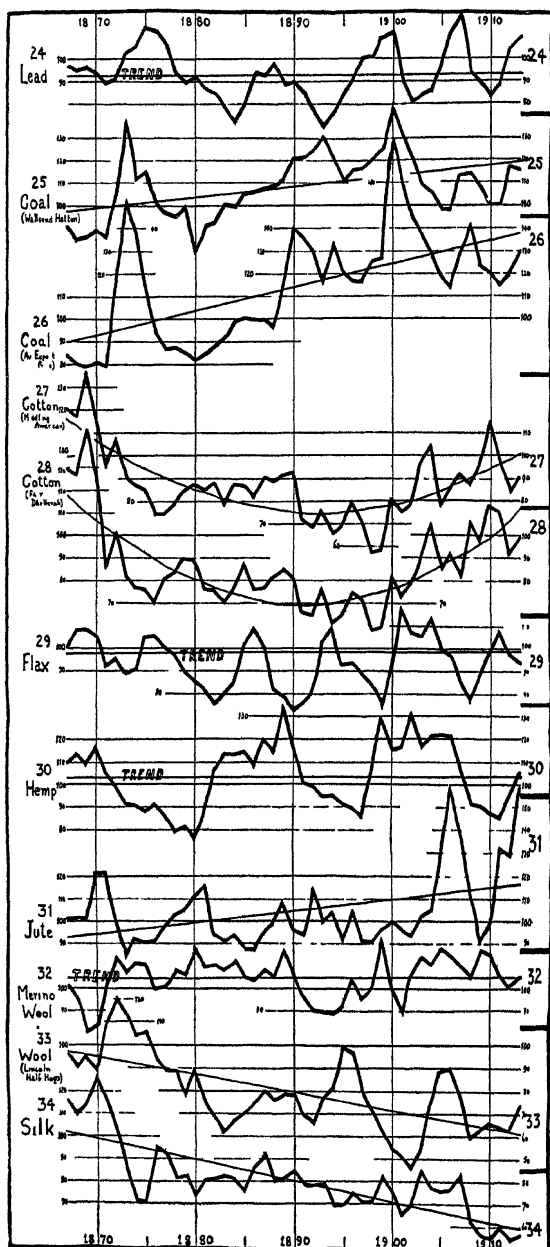
The whole period considered is 1867-1913—forty-seven years.

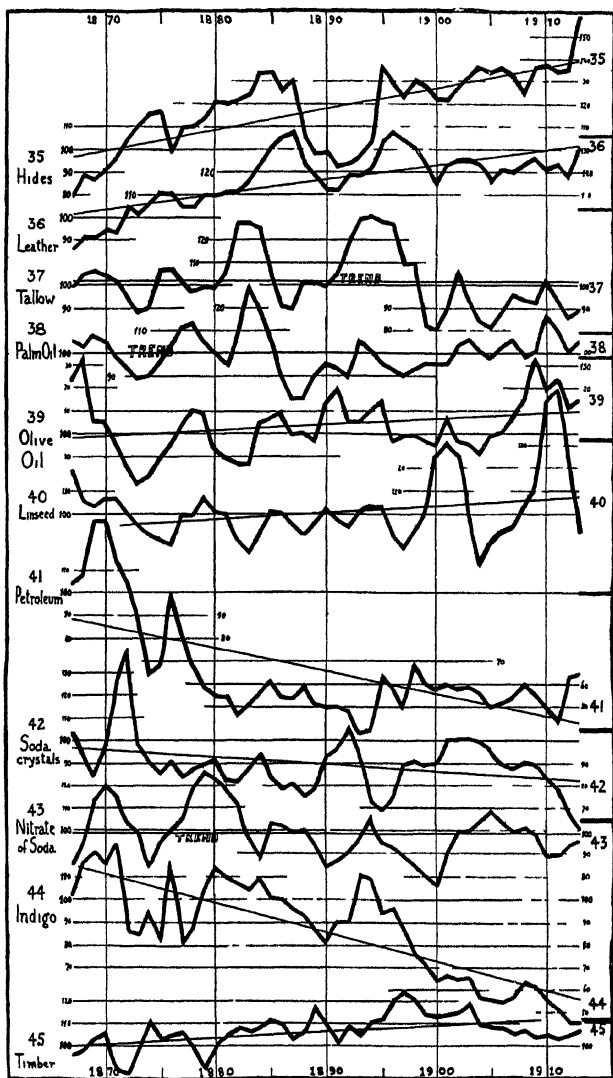
Write x for the index-number of any commodity divided by the general index for the year, rectified so that the resulting average for 1867-77 is still 100.

SAUERBECK'S 45 SERIES EXPRESSED YEAR BY YEAR AS
PERCENTAGES OF HIS GENERAL INDEX-NUMBER









Write \bar{x} for the average of the 47 x 's for a commodity over the 47 years, and write $y = x - \bar{x}$, so that the $\Sigma y = 0$.

Take 1890, the central year of the period, as zero time, and let t be the number of years after 1890.

Then consider the equation $y = a + bt + ct^2 + u$, or $y = a + bt + ct^2 + v$ as representing the value of y at time t .

Here a, b, c are constants to be determined, u is the residual deviation from a straight line, v from a parabola.

Write $|z|$ for the mean value of any quantity z over the 47 years. Then $0 = |t| = |t^3| = |y|$.

First fit a straight line to the y 's by the method of least squares.

The conditions for a minimum of Σu^2 give

$$\begin{aligned} a + |y| &= 0 \\ b|t^2| &= |yt|, \end{aligned}$$

whence

$$\begin{aligned} |u| &= |y| - a - b|t| = 0 \\ |ut| &= |yt| - a|t| - b|t^2| = 0. \end{aligned}$$

Also

$$\begin{aligned} \sigma_u^2 &= |y^2| = a^2 + b^2|t^2| + 2ab|t| + 2a|u| + 2b|ut| + \sigma_u^2 \\ &= b^2|t^2| + \sigma_u^2 \end{aligned}$$

where

$$\sigma_u^2 = |u^2|.$$

Next fit a parabola to the y 's.

The conditions for a minimum of Σv^2 give

$$\begin{aligned} a + c|t^2| &= 0 \\ b|t^2| &= |yt| \\ a|t^2| + c|t^4| &= |yt^2|, \end{aligned}$$

whence

$$\begin{aligned} |v| &= |y| - a - b|t| - c|t^2| = 0 \\ |vt| &= |yt| - a|t| - b|t^2| - c|t^3| = 0 \\ |vt^2| &= |yt^2| - a|t^2| - b|t^3| - c|t^4| = 0. \end{aligned}$$

The residuals are therefore completely uncorrelated with the time.

Also

$$\begin{aligned} \sigma_v^2 &= a^2 + b^2|t^2| + c^2|t^4| + 2ac|t^2| + \sigma_v^2 \\ &= b^2|t^2| + c^2\{|t^4| - |t^2|^2\} + \sigma_v^2, \end{aligned}$$

since

$$\{a + c|t^2|\}^2 = 0.$$

$$\therefore \sigma_v^2 = \sigma_y^2 - b^2|t^2| - c^2\{|t^4| - |t^2|^2\} = \sigma_u^2 - c^2\{|t^4| - |t^2|^2\}.$$

If n is the whole number of years, then, whether t be odd or even,

$$|t^2| = \frac{n^2-1}{12}, |t^4| = |t^2| \times \frac{3n^2-7}{20}, |t^4| - |t^2|^2 = \frac{(n^2-1)(n^2-4)}{180}$$

so that

$$\begin{aligned}\sigma_y^2 &= \sigma_y^2 - \frac{n^2-1}{12} \cdot b^2 - \frac{n^2-1}{12} \cdot \frac{n^2-4}{15} c^2 \\ &= \sigma_y^2 - 184b^2 - 184 \times 147c^2,\end{aligned}$$

when, as here, $n = 47$;

and

$$\sigma_u^2 = \sigma_y^2 - \frac{n^2-1}{12} b^2 = \sigma_y^2 - 184b^2.$$

Also

$$b = \frac{12|yt|}{n^2-1} = \frac{|yt|}{184},$$

and in the case of the parabola

$$c = \frac{|yt^2|}{|t^4| - |t^2|^2} = \frac{180|yt^2|}{(n^2-1)(n^2-4)} = \frac{|yt^2|}{184 \times 147}$$

and

$$a = -\frac{12|yt^2|}{n^2-1} = -\frac{|yt^2|}{184}.$$

The calculation of a , b , c , σ_u , σ_v from the observations is then a simple task after σ_y is determined.

A measure of the significance of b and c may be thus determined:—

If there were no trend, and the y 's were distributed at random about zero, the value of b , viz.,

$$|yt| \div |t^2| = \Sigma(yt) \div \Sigma(t^2),$$

would be fortuitous.

Therefore

$$\begin{aligned}\sigma_b^2 &= \sigma_y^2 \cdot \Sigma t^2 + \{\Sigma t^2\}^2 = \sigma_y^2 \div \Sigma t^2 \\ \sigma_b &= \sigma_y \times \sqrt{\frac{12}{n(n^2-1)}} = \sigma_y \div 93 \text{ approximately.}\end{aligned}$$

Similarly

$$\begin{aligned}\sigma_c^2 &= \sigma_y^2 \cdot \Sigma t^4 + \{\Sigma t^4 - (\Sigma t^2)^2\}^2 = \frac{\sigma_y^2 \cdot 135 \cdot (3n^2-7)}{n(n^2-1)(n^2-4)^2} \\ \sigma_c &= \sigma_y \div 751.\end{aligned}$$

In the accompanying table the values of $\sigma_y, \sigma_u, \sigma_v, a, b, c, \sigma_a, \sigma_b$ are given for each commodity for which they are significant, significance being judged in many cases from the diagrams. In the diagrams the resulting straight lines or parabolas are drawn. In 10 cases there is no significant trend, in 26 the straight line appears to be sufficient, in 9 cases a parabola is used. The final column shows the divergence from 100 reached by the straight line or parabola in 1913.

The algebraic analysis for correlation is as follows.

Let $y', a', b', c', u', v', \sigma_y', \sigma_u', \sigma_v'$ be the quantities for a second commodity.

$$\begin{aligned} |yy'| &= |(a + bt + ct^2 + v)(a' + b't + c't^2 + v')| \\ &= aa' + (bb' + ac' + ca')|t^2| + cc'|t^4| + |vv'|, \end{aligned}$$

the remaining terms being zero.

Now

$$a + c|t^2| = 0 = a' + c'|t^2|,$$

$$\therefore |vv'| = |yy'| - bb'|t^2| - cc'\{|t^4| - |t^2|^2\},$$

and similarly

$$|uu'| = |yy'| - bb'|t^2|,$$

if a straight line is used.

In the present case,

$$|uu'| = |yy'| - 184bb',$$

and

$$|vv'| = |uu'| - 184 \times 147cc'.$$

From these equations $r_{yy'}, r_{uu'}, r_{vv'}$ can be calculated, when $|yy'|$ is determined, without the necessity of ascertaining the separate u 's and v 's.

In the case where two series are sufficiently determined by rectilinear trends and fluctuations therefrom, it is interesting to see what are the relative contributions to the correlation of the trends (which may give "nonsense correlations") and the fluctuations.

We have

$$r_{yy'} = \sqrt{\frac{bb' \times \frac{n^2-1}{12} + r_{uu'} \cdot \sigma_u \sigma_u'}{\left(b^2 \times \frac{n^2-1}{12} + u^2\right) \left(b'^2 \times \frac{n^2-1}{12} + \sigma_u'^2\right)}}$$

Computed constants for lines of trend, etc.

1867-77 = 100 throughout, except for No. 2, where 1871-77 = 100.

Commodities.	Standard deviation of relative index.	Rectilinear constants.		Parabolic constants.		σ_y	z
		σ_u	$b \pm \sigma_b$	σ_u	a	$c \pm \sigma_c$	
1. Wheat, English ...	13.3	—	.73 ± .14	8.9	—	—	-31.5
2. Wheat, American ...	10.9	—	.55 ± .12	8.5	—	—	-20.4
3. Flour ...	9.3	—	.36 ± .10	8.0	—	—	-16.6
4. Barley ...	9.0	—	.40 ± .10	7.0	—	—	-13.6
5. Oats ...	8.4	—	.19 ± .09	8.0	—	—	-6.1
6. Maize ...	11.6	—	—	—	—	—	0
7. Potatoes ...	17.3	—	.435 ± .18	16.3	—	—	-22.8
8. Rice ...	8.6	—	—	—	—	—	0
9. Beef, prime ...	10.9	+	.40 ± .12	9.5	8.2	.045 ± .014	+7.2
10. Beef, middling ...	10.0	+	.40 ± .11	8.4	4.1	.022 ± .013	+13.2
11. Mutton, prime ...	15.1	+	.47 ± .16	13.7	13.0	.071 ± .020	+6.3
12. Mutton, middling ...	11.2	+	.42 ± .12	9.4	5.3	.029 ± .015	+8.2
13. Pork ...	13.2	+	.53 ± .14	11.0	6.4	.034 ± .018	+15.5
14. Bacon ...	12.4	+	.38 ± .13	11.2	8.2	.045 ± .017	+8.1
15. Butter ...	10.1	+	.44 ± .11	8.2	5.9	.032 ± .013	+12.7
16. Sugar, W.I. and beet ...	19.7	+	1.28 ± .22	9.3	—	—	-50.0
17. Sugar, Java ...	20.7	—	1.37 ± .23	9.1	—	—	-47.1
18. Coffee ...	31.5	—	—	—	—	—	0
19. Tea ...	16.3	—	1.13 ± .18	5.6	—	—	-47.6
20. Pig-iron ...	16.9	+	.41 ± .18	15.9	—	—	+9.7
21. Iron bars ...	17.0	+	.45 ± .18	15.9	—	—	+8.4
22. Copper ...	18.1	+	.50 ± .19	16.8	—	—	+17.3
23. Tin ...	44.6	+	2.58 ± .48	27.6	—	—	+92.9

Divergence of index in 1913 due to a, b, c .

Computed constants for lines of trend, etc.—Contd.
 1867-77 = 100 throughout, except for No. 2, where 1871-77 = 100.

Commodities.	Standard deviation of relative index.	Rectilinear constants.			Parabolic constants.		Divergence of index in 1913 due to a, b, c .
	σ_y	$b \pm \sigma_b$	σ_u	a	$c \pm \sigma_c$	σ_y	z
24. Lead	11.7	—	—	—	—	—	0
25. Coal, Wallsend	13.9	+ .46 \pm .15	12.4	—	—	—	+18.6
26. Coal, export	23.6	+ 1.06 \pm .25	18.7	—	—	—	+38.4
27. Cotton, U.S.	15.0	+ .84 \pm .16	14.2	-11.8	+ .064 \pm .020	9.5	+1.1
28. Cotton, Indian	18.6	- .21 \pm .20	18.5	-16.4	+ .089 \pm .025	11.1	+12.0
29. Flax	11.6	—	—	—	—	—	0
30. Hemp	14.6	—	—	—	—	—	0
31. Jute	17.2	+ .51 \pm .18	15.7	—	—	—	+16.1
32. Wool, Australian	9.4	—	—	—	—	—	0
33. Wool, English	16.6	+ .79 \pm .18	12.7	—	—	—	-29.2
34. Silk	16.1	+ .92 \pm .18	10.2	—	—	—	-40.7
35. Hides	17.0	+ .92 \pm .18	11.6	—	—	—	+38.8
36. Leather	12.3	+ .65 \pm .13	8.6	—	—	—	+31.8
37. Tallow	13.2	—	—	—	—	—	0
38. Palm oil	9.6	—	—	—	—	—	0
39. Olive oil	12.4	+ .25 \pm .13	11.9	—	—	—	+9.6
40. Linseed oil	15.4	+ .30 \pm .17	14.9	—	—	—	+7.3
41. Petroleum	22.2	+ .99 \pm .24	17.6	—	—	—	-37.5
42. Soda crystals	13.5	+ .23 \pm .14	12.7	—	—	—	-18.2
43. Soda nitrate	11.9	—	—	—	—	—	0
44. Indigo	21.7	- 1.31 \pm .23	12.4	—	—	—	-44.7
45. Timber	9.1	+ .27 \pm .10	8.3	—	—	—	+13.1

Write $bn = 2l\sigma_u$, $b'n = 2l'\sigma_u'$, so that l , l' are the ratios of the linear increase in half the whole period under consideration to the standard deviations of the deviations from the line.

Then, approximately, neglecting $\frac{1}{n}$,

$$r_{yy'} = \frac{\frac{1}{3}l'l' + r_{uu'}}{\sqrt{\{(\frac{1}{3}l^2 + 1)(\frac{1}{3}l'^2 + 1)\}}}.$$

The contributions to the complete correlation of two time-series by the linear trends and the correlation ($r_{uu'}$) between the deviations therefrom are in the ratio $\frac{1}{3}l'l'$ to $r_{uu'}$ approximately.

Notice that if

$$b' = 0, r_{uu'} = r_{yy'} \times \frac{\sigma_x}{\sigma_u}.$$

There are 990 correlations between pairs of 45 series, and it is evidently too long a task to compute all. The procedure adopted was as follows:—All the correlations in the vegetable-food group were computed, and all in the animal-food group, in the sugar group, in the mineral and in the textile group.* In the miscellaneous group all correlations between products that appeared to be of similar origin or competitive with each other were tested. Further, a number of correlations from one group to another were computed, such as beef and hides, mutton and wool. Of course, wherever neither b nor b' was zero some correlation would be found, but it was not to the point to consider correlations due only to trend. Only 52 correlations were found in which the coefficient was as great as .30, and only 35 survived when the rectilinear trend was eliminated. Coefficients less than .30 are less than twice their standard deviation measured by the formula $(1-r^2) \div \sqrt{n}$, and have very little effect in the final estimate. Also there appeared to be a tendency, due to some neglect of small quantities inherent in the general method followed, to reach positive rather than negative correlations when, in fact, no correlation could be expected, so that it is not unlikely that all the coefficients are a little too great. It is believed that with full

* Mr. J. Brace did a great deal of arithmetical work for the preliminary stages of the memorandum, especially in providing data for the diagrams and in computing a great number of correlation coefficients on various methods and for various periods. This made it possible to ignore a number of correlations that might have been expected *a priori* to be significant. He very kindly placed this mass of material at my disposal, and should have been regarded as the joint author of this memorandum, if it had been practicable to consult him with regard to its development. I have also to thank Mr. E. C. Rhodes for help, especially in proof-reading.

working of all the 990 coefficients after elimination of all significant trends and with allowance for the effect of some necessary algebraic relations between them, the results that follow would not be sensibly affected.

In the following table are shown the coefficients that appeared to be significant, and are subsequently used. In each case the first entry is the coefficient between y and y' before the rectilinear trend is removed, the second is between u and u' , and where a parabolic trend was used a third entry for the correlation between v and v' is made.

It may be noted that if r_{12} , r_{23} , r_{31} are the correlation coefficients between three quantities, then $1 + 2r_{12}r_{23}r_{31} - r_{12}^2 - r_{23}^2 - r_{31}^2 > 0$, since the left-hand side is expressible as the sum of squares.

$$\therefore (1 - r_{23})(1 + r_{23} - 2r_{12}r_{31}) > (r_{12} - r_{31})^2 > 0.$$

$$\begin{aligned} \therefore r_{23} &> 2r_{12}r_{31} - 1 + \frac{(r_{12} - r_{31})^2}{1 - r_{23}} \\ &> 2r_{12}r_{31} - 1 + (r_{12} - r_{31})^2 \\ &> r_{12}^2 + r_{31}^2 - 1. \end{aligned}$$

Hence, if the sum of the squares of r_{12} and r_{31} is greater than 1, r_{23} is positive.

Coefficients of correlation.

In each case the first entry is $r_{yy'}$, the second $r_{uu'}$, and if there is a third it is $r_{vv'}$.

	English wheat.	American wheat.	Flour.	Barley.	Oats.	Potatoes.
American wheat . .	.94 .93	— —	— —	— —	— —	— —
Flour ....	.78 .69	.92 .84	— —	— —	— —	— —
Barley ....	.67 .40	.46 .17	.60 .435	— —	— —	— —
Oats ....	.31 .08	— —	— —	.70 .68	— —	— —
Maize ....	.43 .45	— —	.42 .38	— —	.30 .27	— —
Potatoes . .	.32 .09	.44 .42	.39 .26	.38 .26	— —	— —
Rice ...	.39	.26	.41	—	—	.30

Coefficients of correlation—Contd.

	Beef, prime.	Beef, middling.	Mutton, prime.	Mutton, middling	Pork.
Beef, middling ....	.81 .74 .52	— — —	— — —	— — —	— — —
Mutton, prime ...	.78 .63 0	.61 .50 .33	— — —	— — —	— — —
Mutton, middling ....	.64 .55 0	.66 .54 .41	.82 .81 .81	— — —	— — —
Pork ....	.72 .62 .30	.61 .46 .31	.55 .13 0	.51 .32 0	— — —
Bacon . . . . .	.69 .61 .19	.62 .51 .33	.68 .61 .16	.59 .49 .33	.86 .84 .77

	Pig iron.	Iron bars.	Copper.	Coal, Wallsend.
Iron bars ....	.72 .70	— —	— —	— —
Copper	— —	.56 .49	— —	— —
Tin	— —	.50 .37	— —	— —
Lead	— —	.36 .36	.61 .61	— —
Coal, Wallsend ....	.65 .60	.74 .70	— —	— —
Coal, export ....	.77 .76	.88 .88	— —	.875 .85

	Sugar, W.I. and beet.	Sugar, Java.
Sugar, Java ...	.99 .94	— —
Tea ....	.89 0	.82 0
Cotton, American and Indian ....	.89,	.90, .76
Hides and leather ....	.60,	.18
Tallow and palm oil ...	.30,	.30
Olive oil and linsced ...	.46,	.12
Hides and English wool .	.44,	0

For example, the correlation coefficient between English wheat and American wheat is $\cdot 93$, and that between English wheat and flour is $\cdot 69$. Hence that between American wheat and flour must be greater than $\cdot 93^2 + \cdot 69^2 - 1$, i.e. $> \cdot 34$. But if we take maize instead of flour, the correlation coefficient between American wheat and maize is on this test only given as greater than $\cdot 93^2 + \cdot 45^2 - 1$, i.e. $> \cdot 07$, and need not be significant.

Also, from the same inequality, r_{23} is within the limits $r_{21}r_{31} \pm \sqrt{\{(1-r_{12}^2)(1-r_{31}^2)\}}$.

Hence the correlation coefficient between American wheat and flour is within $\cdot 64 \pm \cdot 27$, and is in fact $\cdot 84$, and that between American wheat and maize is within $\cdot 42 \pm \cdot 33$, and is in fact near the lower limit.

The *Statist* index-number for 1913, viz. 85, is the average of 45 numbers obtained by expressing for each of 45 commodities its 1913 price as a percentage of its average price in the eleven years 1867 to 1877. If these 45 percentages are regarded as random and uncorrelated samples from an indefinitely large number of similarly computed percentages, then the standard deviation resulting from sampling is $\sigma \div \sqrt{45}$, where σ is the standard deviation for all percentages. If, however, σ is computed from the given 45 percentages, whose average is subject to deviation, we should write $\sigma \div \sqrt{44}$ for the standard deviation of the average. σ so computed is 27.4, and $\sigma \div \sqrt{44}$ is 4.13. We might, then, on this hypothesis write the index-number as 85 ± 4.13 , and say that its standard deviation is 4.9 per cent. of itself.

If, however, the percentages, still regarded as samples, are correlated, we can no longer regard them as independent choices from the hypothetical frequency-curve. The only way of determining the correlations is to observe the movements over a series of years. For each of 47 years the computation of y in the table already discussed gives a frequency-curve consisting of 45 deviations from the average of the year taken as 100. Suppose a table to be drawn up in which the 47×45 values of y are entered, the years being shown horizontally and the commodities vertically. The column σ_y (table, pp. 309-10) gives the standard deviation of the 47 horizontal entries for each commodity, of the entries in fact shown in the diagrams. The correlations, $r_{yy'}$, are determined from pairs of these lines. Each vertical, or annual, group is a selection of 45 correlated variables. Write σ_1 for the standard deviation of the average of these groups.

Then

$$45^2\sigma_1^2 = |(\Sigma y)^2| = \Sigma\sigma_y^2 + 2\Sigma r_{yy'}\sigma_y\sigma_{y'},^*$$

where the summations are extended over the 45 commodities and the 990 correlations.

When correlation coefficients less than .30 are neglected, it is computed that

$$45^2\sigma_1^2 = 12,100 + 13,000, \text{ and } \sigma_1 = 3.52.$$

If all the correlations had been zero, then we should have had $\sqrt{12,100} \div 45 = 2.44$.

These are the mean measurements for 47 years and are less than that named above for 1913 (4.9), since the standard deviation, when the trend is not eliminated, increases with the lapse of time from the starting-point.

Next take each y in the form $a + bt + ct^2 + v$, that is as the sum of an element depending on the time and of a residual. Regard the time element as peculiar to each commodity, and neglect the part of the correlation due to it. Write σ_2 for the resulting standard deviation of the average.

$$\begin{aligned} 45^2\sigma_2^2 &= |\Sigma(a + bt + ct^2 + v)^2| \\ &= |\Sigma(a + bt + ct^2)^2| + |(\Sigma v)^2|, \end{aligned}$$

since $0 = \Sigma v = \Sigma vt = \Sigma vt^2$ for each commodity,

$$= |t^2|\Sigma b^2 + \{|t^4| - |t^2|^2\}\Sigma c^2 + \Sigma\sigma_v^2 + 2\Sigma r_{vv'}\sigma_v\sigma_{v'},$$

since each $a + c|t^2| = 0$, and $0 = |t| = |t^3|$,

$$= \Sigma\sigma_v^2 + 2\Sigma r_{vv'}\sigma_v\sigma_{v'}.$$

This may otherwise be obtained by using the equations connecting $|yy'|$, $|uu'|$, $|vv'|$ and ignoring bb' and cc' throughout.

Where $a = c = 0$, there σ_v , σ_v' , $r_{vv'}$ are to be replaced by σ_u , σ_u' , $r_{uu'}$, and where also $b = 0$ by σ_y , σ_y' , $r_{yy'}$.

It is found that $2\Sigma r_{vv'}\sigma_v\sigma_{v'} = 5,300$, while $\Sigma\sigma_v^2 = 12,100$ as before.

$$\therefore 45^2\sigma_2^2 = 12,100 + 5,300, \text{ and } \sigma_2 = 2.94,$$

where σ_2 is the mean over 47 years.

The neglect of the correlations due to the trend has diminished

* It has seemed unnecessary to allow for the fact that these standard deviations are computed from a variable average and to write 44 for 45 in the denominator. The resulting difference in the standard deviation would only be about 1 per cent., and in the calculation of the "equivalent numbers" would be cancelled.

† Using the values of σ_y^2 , p. 306 above, line 3 from bottom.

the standard deviation from 3.52 to 2.94, while if all correlations were neglected it would be 2.44.

The index-number is then assumed to result to a combination of 45 random selections of the form $a + bt + ct^2$, and 45 correlated selections v . The latter is independent of the year, the former increases as we progress from the starting-point; so that as time goes on the correlations between the residuals become of less and less relative importance.

The values of $a + bt + ct^2$, expressed as percentage changes since the starting-point, are given under the column headed z in the table (pp. 309-10) for the year 1913.

$$45^2\sigma_z^2 = \Sigma z^2 - |\Sigma z|^2 = 30,700 - 14^2, \text{ and } \sigma_z = 3.88.$$

σ_3 , the percentage standard deviation appropriate to 1913, is then given by

$$\begin{aligned} 45^2\sigma_3^2 &= \Sigma(z - \bar{z})^2 + |(\Sigma v)^2| = 45^2\sigma_z^2 + \Sigma\sigma_v^2 + 2\Sigma r_{vv'}\sigma_v\sigma_{v'} \\ &= 30,500 + 7,700 + 5,300, \end{aligned}$$

where $\Sigma\sigma_v^2 = 7,700$,

$$= 38,200 + 5,300 = 43,500.$$

$$\therefore \sigma_3 = 4.63.$$

This is per 100; the equivalent for the 1913 actual index, 85, is 3.93.

If there had been no correlation between the residuals, σ_3 would have been $\sqrt{38,200} \div 45 = 4.34$, that is less than the 4.9 per cent. obtained by our first inspection of the 1913 index-numbers only; the numbers in 1913 were in fact more dispersed than in previous years.

The index-number for 1913 may now be written as 85 ± 3.93 .

To determine the number of independent entries equivalent to the 45 correlated entries, we may proceed as follows. Let s^2 be the average of the squares of the standard deviations of the commodity-series, so that $45s^2 = 38,200$, $s^2 = 850$.

Then

$$\sigma_3 = \sqrt{\frac{43,500}{45^2}} = \sqrt{\frac{51.18s^2}{45^2}} = \frac{s}{\sqrt{39.5}}.$$

The number 39.5 may also be obtained as $\frac{38,200}{43,500}$ of 45.

Thus 39.5 independent entries, each with the standard deviation s , would give the same standard deviation as the 45 actual entries in 1913.

For the mean of the 47 years the equivalent number of entries is obtained from the σ_2 equations as $\frac{12,100}{17,400}$ of 45 = 31.3.

The possible effect of the correlations neglected, as being less than .3, may be judged by considering the addition of, say, 10 correlations each of .15 between commodities whose standard deviation is s .

We should have

$$45^2 \sigma_s'^2 = 51 \cdot 2s^2 + 2 \times 10 \times .15s^2 = 54 \cdot 2s^2$$

$$\sigma_s' = \frac{\sqrt{54 \cdot 2 \times 850}}{45} = 4.75,$$

and the number of equivalent entries for 1913 is $45^2 - 54 \cdot 2 = 37.4$.

It must be decided arbitrarily what correlations are negligible; correlations between food and metals, for example, are unlikely to be real. Of the 990 possible correlations, many of the small ones are negative, and their inclusion would increase the precision.

It remains to consider what additional security Mr. Sauerbeck obtained by taking the average of the price-relatives of 2 brands in 10 or 11 of the numbers he used.

Write $100 + {}_1w_p$, $100 + {}_2w_p$ for the price-relatives of the 2 brands of the p 'th commodity.

Then the index-number is $100 + \frac{\frac{1}{2} \sum ({}_1w_p + {}_2w_p) + \sum y}{45}$, the first summation being extended over the duplicated commodities, the second over the rest.

The standard deviation of the number is

$$\sqrt{\frac{1}{2} \sum ({}_1\sigma_p^2 + {}_2\sigma_p^2 + 2r_1\sigma_p \cdot {}_2\sigma_p) + \sum \sigma_y^2}.$$

If all the standard deviations were equal to σ , and 10 commodities were duplicated, this becomes

$$\sqrt{40 + \frac{1}{2} \sum r} \sigma.$$

If the correlation were perfect this reduces to $\frac{\sigma}{\sqrt{45}}$ and no advantage is gained.

If each $r=0$, it reduces to $\sigma \cdot \sqrt{\frac{40}{45^2}} = \frac{\sigma}{\sqrt{50.6}}$, and we have the equivalent of 50.6 independent commodities.

Actually we find the following values for r in the 10 duplicated commodities:—sugar, .81; coffee, .745; tea, .62; iron, .90;

flax, .85; hemp, 0; Australian wool, .13; hides, .90; seeds, 1.0; timber, 0. The expression $\frac{1}{2}\sum(\sigma_p^2 + \sigma_q^2) = 1,512$, to which the correlation terms add 816. The two together, 2,328, form the contribution of these 10 commodities to the numerator 13,500 already used for the 45 commodities. That numerator may now be written as $37,400 + 800 + 5,300 = 43,500$, in which the last two terms are due to correlation.

Correlation then reduces the number, 50.6, of independent commodities which result from 20 at half weights and 35 at full weights to

$$\frac{37,400}{43,500} \text{ of } 50.6 = 43.5,$$

that is, the resulting standard deviation is $\frac{s}{\sqrt{43.5}}$ where s^2 is the mean of the 55 squared standard deviations, 20 of which have half weights.

On this method, then, Mr. Sauerbeck's treatment of 55 commodities after the lapse of 41 years appears to be equivalent to the inclusion of 43.5 uncorrelated commodities, each with the standard deviation that is typical of the 55. It is also equivalent to 39.5 independent commodities, each with the smaller standard deviation typical of the 45, when 10 pairs have been averaged together.* In both cases the standard deviation of the average is the same, viz. 4.63 per cent.

Mr. Sauerbeck no doubt selected the commodities originally with some reference to their relative importance in the national economy, and possibly also with a view to their price-movements being representative of price-movements in general in the steadiness of some and the rapid fluctuations of others. The method of the index-number is equivalent to taking a physical budget containing the quantity of each commodity that could be purchased for £100 in 1867-77 and valuing these quantities by the prices of each successive year. In 41 years the relative importance of these commodities has changed and the number has become practically a random sample of price-relatives. Our hypothesis has been that each commodity-price has followed its own independent secular movement in relation to prices in general, and that the index is a random choice of the result of 45 independent secular movements, combined with short-period correlated variations.

* In the Memorandum of the Economic Service referred to above, the equivalent number of independent commodities was very roughly computed by *a priori* methods as 40, for the 14 years 1899 to 1913.

It would of course be possible to include the full correlations, secular and short period, between closely related pairs of commodities, such as English and American wheat and prime and middling beef, and the data given in this article make the computation possible ; we have to add $2 \times 184 (bb' + 147cc')$ to the numerator of σ_s^2 for each pair transferred from $r_{rv}\sigma_v\sigma_v'$ to $r_{yy'}\sigma_y\sigma_y'$. For the two wheats the addition is 147, for the two beefs 112, for the two muttons 128, and for pork and bacon 93. If we thus modify these four, σ_s is raised from 4.63 to 4.66, and the "equivalent number" of entries lowered from 39.5 to 39.1. The difference is very slight, and it is doubtful whether the result is actually more accurate.

PROFESSOR TSCHUPROW ON THE THEORY OF CORRELATION.

By MAJOR GREENWOOD.

FIVE years ago, in his *Treatise on Probability*, Mr. J. M. Keynes, writing of the work of our honorary fellow Professor A. L. Tschuprow, and of his predecessors Markoff and Tchebycheff, said: "The Laplacian mathematics, although it still holds the field in most text-books, is really obsolete, and ought to be replaced by the very beautiful work which we owe to these three Russians."*

Mr. Keynes was specifically referring to two memoirs by Professor Tschuprow published in the *Skandinavisk Aktuarietidskrift*†; since then Professor Tschuprow has published several papers in statistical journals, including one in our own,‡ which exhibit fully his methods of solving problems of mathematical statistics. Unlike most Continental mathematicians, who have usually either ignored English biometric developments or mentioned them with a certain flavour of disparagement—the late Professor Czuber was, however, a conspicuous exception—Professor Tschuprow has always recognized the importance of what has been done by Professor Karl Pearson and his School.

Professor Tschuprow has now devoted a separate volume to the elements of that statistical calculus which, more than any other, has been the work of Englishmen—the Calculus of Correlation.§

The publication of this volume is therefore a fitting moment to refer to the characteristics of Professor Tschuprow's work, illustrating one's observations chiefly from the book on correlation.

Isaac Todhunter devoted the 18th Chapter of his *History of the Mathematical Theory of Probability* to an examination of the writings of Trembley of Geneva (1749–1811) on probability. The

* *A Treatise on Probability*, London, 1921, p. 358.

† *Skand. Aktuarietidskrift*, 1918, p. 199; 1919, p. 80 *Biometrika*, vol. xii, 1919, pp. 140, 185; vol. xiii, 1921, p. 283. *Metron*, vol. i, pt. 4, p. 41; vol. ii, pp. 461, 646.

‡ *Journ. Roy. Stat. Soc.*, vol. lxxxviii, p. 91.

§ *Grundbegriffe und Grundprobleme der Korrelations-theorie*, 153 pp. (Published by B. G. Teubner, Leipzig, 1925. Price R.M. 8.)

first of these, printed by the Royal Society of Sciences of Göttingen in 1796, begins as follows (I translate from the Latin) :—

“There exist many scattered analytical meditations on the Calculus of Probabilities which I do not propose to discuss. While these for the most part are concerned with particular questions, the consummate mathematicians Laplace and Lagrange have dealt with the theory on more general lines, deriving assistance from the most intimate parts of the integral calculus, and have indeed obtained results of the highest value. But since the whole theory of probability depends upon simple and obvious principles involving hardly anything more than the doctrine of combinations, and most of the difficulties are really those of enumerating and distinguishing the cases, I have thought it expedient to examine some of the more general problems by an elementary method, without any extraneous aid. These pages contain a first specimen, viz., elementary solutions of some general problems the solutions of which were contributed to the proceedings of the Royal Academy of Berlin in 1775 by the illustrious Lagrange. Should these not be displeasing to mathematicians, I intend, with the help of God, on other occasions to put forward similar papers.”

Isaac Todhunter's analysis of Trembley's writings has something of that quality which the philistine calls the “Cambridge manner.” “Trembley's methods,” he writes, “are laborious, and like many other attempts to bring high mathematical investigations into more elementary forms, would probably cost a student more trouble than if he were to set to work to enlarge his mathematical knowledge and then study the original methods.” There is, as we shall see, much to be said for a part of this dictum, but it is likely that some philistine may recollect a sarcasm of Mr. Lytton Strachey. The great Dr. Arnold had said that “the study of language seems to me as if it was given for the very purpose of forming the human mind in youth ; and the Greek and Latin languages seem the very instruments by which this is to be effected.” “Certainly,” comments Mr. Strachey, “there was something providential about it—from the point of view of the teacher as well as of the taught. If Greek and Latin had not been ‘given’ in that convenient manner, Dr. Arnold, who had spent his life in acquiring these languages, might have discovered that he had acquired them in vain.” The relevance of this is that Professor Tschuprow has always attached the greatest importance to the use of “elementary” methods of demonstration and that, with few exceptions, the difficulties a reader of his statistical papers has to face are *intrinsic* difficulties. An analogy may help to explain the position. A has written in French and B

has written in English an account of the same transactions; both accounts are correct but A's exposition is clearer and more concise than B's. A Frenchman would be foolish to trouble to read B, but an Englishman might find that the difficulties of B's exposition were less formidable than the extrinsic difficulties imposed by the foreign idiom of A. Todhunter would retort that the Englishman had better learn French. He might be justified in giving that advice. If, however, it *did* chance that the prolix English story corrected mistakes in the concise French account, or mistakes that a foreign reader of the French account might be likely to fall into through want of familiarity with the language, the advantage of learning French and ignoring B would not be so obvious.

Professor Tschuprow's pupil, Dr. Anderson,* and Professor Tschuprow himself,† have reproached English statisticians, particularly those of the Biometric School, with a neglect of the method of "Mathematical Expectation" in their treatment of statistical problems.

There is a sense in which the accusation is no more than a verbalism.

Suppose that a variable quantity x is susceptible of taking n different values, $x_1, x_2, x_3 \dots x_n$, and that the probability that it will, under certain conditions, assume the value x_i is p_i with the conditions $\sum_{i=1}^{i=n} p_i = 1$, $\sum_{i=1}^{i=n} p_i x_i$ is the weighted mean value of x ; and whether we choose to write this as \bar{x} or as $E(x)$ is surely as much a matter of taste as whether one speaks of the "arithmetic mean" or the "arithmetic average," *provided* one distinguishes between an empirical and a universal mean.

The gravamen is, I think, not that our English principles are faulty, but our practice.

If y , a function of some chance variable x , is equal, say, to $f(x)$ and we wish to find the standard error of y , we usually resort to "statistical differentials," *i.e.* we "neglect second-order terms with factors $1/N$," which is "what a member of the Biometric School understands when he replaces 'statistical differentials' by 'mathematical differentials.'"‡ We proceed gaily:—

$$\begin{aligned} dy &= f'(x)dx \\ (dy)^2 &= \{f'(x)\}^2 \cdot (dx)^2, \end{aligned}$$

and so

$$\sigma_y^2 = E\{f'(x)\}^2 \cdot \sigma_x^2.$$

* *Biometrika*, vol. x, 1914, p. 269.

† *Biometrika*, vol. xii, 1918–19, p. 140.

‡ *Biometrika*, vol. xiv, 1922, p. 201.

It is tempting to replace the $E(f'(x))^2$ by $\{Ef'(x)\}^2$, and the result *may* be good enough.

But if we had faced the problem of evaluating

$$E\{f(x) - Ef(x)\}^2 = E(f(x))^2 - \{Ef(x)\}^2$$

by "brute algebra," we might have discovered that what had been neglected was of the essence of the business. Indeed, sometimes it would appear that our approximation was not an approximation at all. The biometrician has, however, this rejoinder: that in many of the simpler cases the short cut is a route to an excellent approximation, and that in a number of not very complicated cases the stringent elementary method involves a very long journey over many weary pages of manuscript beset with opportunities of slips. Just as modern applied statistics, in these days of mechanical calculators and elaborate tables, requires a new race of computers, Professor Tschuprow's treatment of theoretical statistics will require a new race of algebraists, not perhaps learned mathematicians, but capable of a sustained and accurate attention, which can be developed by practice, no doubt, yet is not a very common natural endowment—it may be, not much commoner than a natural capacity for the "higher" mathematics.

The first three chapters of Professor Tschuprow's book, almost a quarter of the whole, is not mathematical in any technical sense; it can be profitably studied by anyone. The distinction between the case of a functional relation between two variables—where the method of correlation is no more than a process of graduation, although a very valuable process of graduation, and of a stochastic (or probability) relation—is made with extreme precision. "There are cases," he writes, "where the conditional mathematical expectation of Y^* corresponds to the true functionally associated value of Y for the given X ; if so, the regression equation of Y upon X gives the functional law of connection between Y and X . There are cases where neither the conditional mathematical expectation of Y nor that of X coincides with the true functionally associated values; if so, the sought law of functional association will be furnished by neither regression equation, and must be investigated by some method appropriate to the special conditions of the problem. And finally there are cases where there can be no question at all of a functional connection between the magnitudes, where their mutual relations are such as to be incapable of description by such a 'law.'

"In that event the regression equations are the definitive expression of those characteristics of the connection between the magnitudes

* Or, as we should say, the mean of the array of Y 's for a given value of X .

which are the object of study interesting to the inquirer, an expression incapable of improvement. The multiplicity of the tasks which a scrutiny of stochastically related variables may impose upon an investigator must never be forgotten by him, that he may choose his method of investigation sensibly and, above all, interpret his results correctly. A trained critical sense is one of the most important pre-requisites of success. One must never lose sight of what one is really trying to establish" (p. 38).

The experienced investigator may not need these cautions, but the student, particularly the student who regards the statistician as a sort of retailer of intellectual ironmongery, is in great need of them, for he very often performs the intellectual equivalent of shaving himself with a chisel and cutting firewood with a safety razor, and is unreasonably annoyed if his chin is sore and if ill-informed persons who have never been to the ironmonger produce much better firewood than his.

In the next two chapters Professor Tschuprow describes the more important measures of correlation. He contrives to cover a good deal more ground than most books, and his notation is, I think, very good. Although it may seem rather redundant to go over the ground twice—viz. first to consider the universals, or, as he writes, the *a priori* relations, then the formally equivalent relations subsisting between the statistical elements of samples, his system of empirical values—the advantage of this course from the learner's point of view is great.

The sixth and most important chapter is devoted to the problem of inferring from the sample the characters of the universal. Two courses are open when, knowing only an empirical U' , we desire to estimate the universal value, U . The first is to choose a function of U' such that its mathematical expectation will be equal to U . The second, and less perfect, is to choose a function of U' such that, as the size of the sample increases, its mathematical expectation will asymptote to the universe-value U . The difficulty of the undertaking resides in the fact that almost the simplest statistical functions involve ratios of variable magnitudes, and to determine exactly the mathematical expectation of a ratio is a problem which has baffled mathematical statisticians in all but the simplest cases. One must be content with approximations to reach which involves algebraical calculations "elementary," indeed, but extremely tedious. Professor Tschuprow has had some mercy upon human weakness and provided, in an appendix, various intermediate steps and hints, but even so the chapter is not easy reading.

In the next chapter Professor Tschuprow briefly considers the

case of samples which are inter-dependent, and of inconstancy of the law of stochastical association within the universe sampled. He obtains a criterion bearing the same relation to the concept of normal correlation that the famous Lexis-Dormay "Q" has to that of normal dispersion.

In the last chapter Professor Tschuprow gives examples of the practical value of the Calculus of Correlations, and his farewell to the reader is expressed in the following terms:—

"But from this we are not to infer that in order to gain a deeper insight into the connection of things, all that is needed is to compute columns of correlation ratios, coefficients, and so on. The modern theory of correlation places at the disposal of the investigator a rich assortment of sharp tools. He who knows how to use them will extract from his numerical data much that would otherwise have remained hidden. But it is never only the quality of the tools which determines the value of the result. A few hasty strokes on a scrap of paper of the hand of a master produce a picture which has more power of moving us than many a conscientious painting brave in all the colours of the rainbow. If the methods elaborated in the theory of correlation are really to give us a deeper understanding of the relations, the statistician using them must be equal to his task. He must not only know how to handle his tools, he must also have fully comprehended the object of the investigation and the nature of the material. He must know how to adapt his technic to the end in view and the possibilities of the case. The most complicated formulæ and the most exact calculations applied mechanically, in a stereotyped way, lead nowhere but to the waste of time and energy and the heaping-up of numerical values ill adapted to add to our real knowledge."

This is an excellent conclusion to a most valuable book.

THE MOMENTS OF THE HYPERGEOMETRIC SERIES.

By H. E. SOPER.

IN the 1925 June number of *Biometrika*, Professor V. Romanovsky considers again the derivation of the moments of the hypergeometric frequencies, and reaches the result given in formula 62¹ of the tract. *Frequency Arrays* (Camb. Univ. Press, 1922), when this is extended to give moments about mean from moments about zero by the usual formula, but advances it by putting for the numerical factor ' E_r ', defined vaguely in the tract by the identity $(e^x - 1)^r = \sum_{r=1}^{\infty} E_r \frac{x^r}{r!}$, its value $\Delta^i(o)^r$ obtained by first expanding the binomial.

The proof given is interesting, but perhaps by some may be thought a little difficult to follow. Commencing with a differential equation satisfied by $F(\alpha, \beta, \gamma, x)$, the hypergeometric frequencies arrayed with powers of the symbol x , Romanovsky obtains a relation between the s th and $s+1$ th derivative of F when $x = 1$. The s th derivative of an array with respect to the symbol x , with x put unity, is plainly a moment function, and may be called the s th pyramidal moment, in that for its evaluation the $t+1$ th frequency is to be multiplied by $t(t-1) \dots$ to s factors, say $(t-)^s$, instead of the usual t^s . Such pyramidal moments would be arrayed as the coefficients of $\beta^s/s!$ if the symbol were put $= 1+\beta$, the ordinary moments being arrayed as the coefficients of $\alpha^s/s!$, when the symbol is put $= e^\alpha$. They are simple expressions for these combinatory distributions and for the hypergeometric series, representing the numbers of units common to two random markings of l and r units in a population of n units, have the values $(l-)^s (r-)^s / (n-)^s$. Romanovsky evaluates these moments, and from them obtains the power moments about the mean m by expanding the factor $(t-m)^s$ appropriate to the latter moments in terms of the pyramidal factors, $1, t, t(t-1) \dots$ by a finite difference expansion. By again expanding in powers of m he obtains μ_s in the desired form.

The earlier proof using simpler mathematics and less mathematical symbolage (which is perhaps apt at times to burden the memory) is repeated here to illustrate the method to those who are unacquainted with it and who may be interested.

Granted that, if the alternative fortuities of a single event are shown as a sum, then the fortuities of a combination of two or more independent events will be shown, by the distributive law of algebra, as the expanded product of such sums, we see that if a sample is to be made by taking (or leaving) A, taking (or leaving) B, etc., the various possible samples are shown as the expanded product

$$(1+A)(1+B) \dots = 1+A+B+ \dots +AB+ \dots + \dots$$

If it is desired to indicate how many are in the sample, the counter S is inserted, and we show all the samples and their magnitude as the array

$$(1+AS)(1+BS) \dots = 1+AS+BS+ \dots +ABS^2+ \dots + \dots$$

The number of samples of each magnitude will be shown as the coefficients in the array

$$(1+S)(1+S) \dots = 1+{}^nC_1S+{}^nC_2S^2+ \dots ,$$

obtained by suppressing the individual symbols, the number of individuals being designated n .

It will now be seen that, if l of the individuals are named A, the remaining $n-l$ being unnamed, the fractional frequency of occurrence of 0, 1, 2 . . . A's in samples of r , drawn as a whole from the n , is arrayed as

$$\text{Coefficient of } S^r \text{ in : } (1+S)^{n-l}(1+AS)^l/{}^nC_r.$$

If this is expanded, the hypergeometric frequencies are seen to result as the coefficients of 1, A, A² . . . , but it is unnecessary to do this, and it only remains, in order to evaluate v_s , the s th moment of the frequencies about the zero, to put $A=e^a$, and find the coefficient of $a^s/s!$ in the expansion in powers of a . The steps are as follows, and we may suppose l not less than r , since "sampling" is only a second "random marking," and the two characterizations are interchangeable.

Coefficient of S^r in :

$$(1+S)^{n-l}\{(1+S)+(A-1)S\}^l/{}^nC_r,$$

$$(1+S)^{n-l}\{(1+S)+(e^a-1)S\}^l/{}^nC_r,$$

$$\begin{aligned} &\{(1+S)^n + l(1+S)^{n-1}S(e^a-1) \\ &\quad + \frac{(l-)^2}{2!}(1+S)^{n-2}S^2(e^a-1)^2+\dots\}/{}^nC_r, \end{aligned}$$

or

$$1 + \frac{lr}{n} (e^{\alpha} - 1) + \frac{(l-)^2 (r-)^2}{(n-)^2 2!} (e^{\alpha} - 1)^2 + \dots \\ + \frac{(l-)^r (r-)^r}{(n-)^r r!} (e^{\alpha} - 1)^r \dots (p)$$

$$\therefore \nu_s = \frac{lr}{n} \Delta(o)^s + \frac{(l-)^2 (r-)^2}{(n-)^2 2!} \Delta^2(o)^s + \dots \\ + \frac{(l-)^s (r-)^s}{(n-)^s s!} \Delta^s(o)^s, (o < s < r+1).$$

The mean is the coefficient of α , which is seen to be lr/n . Calling this m ,

$$\mu_s = \nu_s - {}^s C_1 \nu_{s-1} m + {}^s C_2 \nu_{s-2} m^2 + \dots + (-m)^s,$$

and if we collect the pyramidal moments $\frac{lr}{n}, \frac{(l-)^2 (r-)^2}{(n-)^2} \dots$,

we obtain the result in the form given by Romanovsky, one, it may be said, which is well adapted for calculation.

It will be noticed that, as stated above, the pyramidal moments are the coefficients of $\beta^s/s!$ in the array (see (p)) when A is put $\sqrt{=1+\beta}$; β therefore stands for $A-1$ or for $e^{\alpha}-1$.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*Memorials of Alfred Marshall*. Edited by A. C. Pigou. ix + 518 pp., 8vo. London: Macmillan and Co., 1925. Price 12s. 6d. net.

These "Memorials" may fitly be described as the epitaph, writ large, of a remarkable man. By wide, if not general, consent he was the foremost economist of his day in Britain, and perhaps in the whole world. If greatness be gauged intensively by leadership through pupils occupying teaching posts, there can be no question of the sway of Marshall, even at the close of his long life. Nor, tested extensively, in the large figures cited for the *Principles* and *Elements* alone, would it be easy to name text-books which in our time have had a greater circulation. Influential disciples and a vast public are cogent testimony to eminence. Nor, we are confident, would the claim be withheld by detached observers of this illuminating exhibition of his personality and work. For here we have the broad character, with particular examples, of his interests and thoughts, informally conveyed through private correspondence and fragmentary notes, as well as expressed, more deliberately, but also somewhat less freely, in the occasional printed pieces brought together. Such an open record will not hide whims or failings which may invite criticism;

but, in the judgment of the present reviewer, there can be no reason for altering a tribute offered thirty-four years ago. After the privilege of reading the proofs of the first edition of the book, which, he believes, contains the most essential and enduring contribution of the author to the development of economic science, he essayed an "appreciation" in an early number of the *Economic Journal*. Now, as then, he is sure that Alfred Marshall has a place in the select class of immortals in the temple of Economics. From the more distant undergraduate days when, a raw recruit, if the metaphor may be allowed, he heard his talented commander lecture in the Hall of Balliol, he has felt that he was one of the very few individuals he has had the fortune to know to whom the homage was due that the rare boon of genius exacts. And, as he lately re-read the products of his pen assembled in the book before him, he remarked to himself again and again, perforce, how thin and weak the mass of contemporary economic writing seemed in contrast with their concentrated pith and strong, effective handling. It may be that their writer was a hard rather than a plain expositor, but he never wasted words or employed perhaps one idle expression. We have heard an admiring chagrined correspondent ruefully confess that Marshall could not be caught tripping, and we have also listened to the candid acknowledgment of a disillusioned critic that what you might imagine with complacent assurance had been overlooked or omitted, had generally been stated or dismissed. On how few, if on any, other economists now, or at any time, could such a verdict be entered?

The Memorials consist, firstly, of reminiscences by Professor Edgeworth, Professor Fay and Mr. Benians, preceded by the masterly obituary in the *Economic Journal*, written by Mr. Keynes, and followed by the Editor's own memorial lecture. In Part II are the collected articles, and Part III contains the letters.

Mr. Keynes' full analysis is, we think, almost beyond reproach. Affirmatively it distinguished the additions to economic theory which should be properly attributed to Marshall. Negatively, for the present writer, it partly explained the disappointment that *Money, Credit and Commerce* had caused. The position, we think, deserves exploring. Rightly or wrongly, we believe that systematic application of the central theory of value, as set forth anew by Marshall in the *Principles*, to money and international trade, has yet to be accomplished. We had hoped and anticipated that this was what Marshall himself was about to do, and had been preparing the way in the long interval that followed the first large book. That gap would, however, not be filled, as we view the situation, by the work, first privately circulated, and only given to the general public after the ideas, original at the time when they were formed by Marshall, had, as Mr. Keynes, with the justice that is only due, points out, become, by dint of some practical experience and much controversial heat, common property. The hiatus, it appears to us, would be left open if the contents of the last volume were to be taken as the representation of those conceptions, with the commentary alone that

they had not been welded together, through the natural infirmity of advancing age. The intervening *Industry and Trade* happily betrayed no failure in what was, as we judge, the element of genius in Marshall's intellect—the power, namely, of disentangling from an intertwined surrounding mass the threads of causal connection, measuring their strength and ordering their arrangement. This mission he himself described as the real achievement of the most famous of his predecessors, and the book we have just mentioned was a dazzling revelation of the unique command of this capacity in a fresh sphere if it seemed to postpone what we were looking for with more eagerness. While Mr. Keynes has not answered our question exactly as we should put it, he has, we think, nevertheless shown his wonted acumen by pointing the finger of criticism to an innate defect. He is illuminating, and he is not unjust, when he hints that Marshall was weak rather than strong in “architectonic” aptitude. The large scheme, accordingly, continually growing, of the treatise, becoming an obsession, involved the loss of the gain that might have resulted from the quicker, more frequent and lavish communication of ideas through the channel of the provisional article or piecemeal pamphlet. Pertinent, also, though it be disturbing, is the suggestion, repeated afterwards in his later memoir of Edgeworth, that the utilitarian foundations of economic theorizing, trusted by both economists, may not endure. They may not survive the closer, less indulgent inspection of the sceptics or the hostile. This horoscope, however, may imply extensive wholesale demolition before secure rebuilding can be begun; and we frankly own that we cannot descry an alternative basis for so finished and harmonious a design as that conceived and, in large measure, executed by Marshall. We regret that the upper storeys and the supporting wings we were expecting were not finally added by him; and perhaps they must be considered, as we have supposed, never to have got beyond an outline of some detail, or, at most, a very rough draft of a general plan.

Compared with Mr. Keynes' full-length portrait, which calls for special notice, the sketches, drawn with his accustomed ceremonial deference by Professor Edgeworth and with unmistakable affection and creditable loyalty by Professor Pigou, must be dismissed with the brief comment that they will reward attention. They emphasize aspects and traits which go to form a complete estimate of the economist. Professor Fay brings out with charm some human characteristics of the man, and the attractive likeness he contrives felicitously to present of the affectionate, inspiring friend whom we recall from old Oxford days, is reinforced appropriately by vivid touches added in Mr. Benians' recollections of the lecturer. Professor Pigou will allow us to congratulate him on the propriety and skill of his fulfilment of the “trust” with which he was charged by his predecessor in the Cambridge Chair. His selection of writings seems to us in perfect accord with Marshall's characteristic injunction to aim at brevity, suppress controversy, and decide in the negative where doubt should arise about publication. The material comprised is

representative, but it would, we think, have failed in that respect had not the letters of the third part been included by the Editor. The help given by Mrs. Marshall, especially in the full and excellent index, is, we may be permitted to remark, an affecting conclusion to the loving care which conserved to an age, prolonged not merely beyond what might have been expected from the accompaniment of ill-health, but also outside the normal span of life, working capacity invaluable to the economic world.

For, we will ask in conclusion, is it possible, with the help of these articles and letters, to attempt a summary reckoning of the debt owing to Marshall by our generation of economists? It would not be easy to add anything of importance to what has been better expressed in this book by others; and, as we hinted at the beginning of this notice, we are tempted to repeat briefly what we wrote at length a third of a century ago. The articles reproduced here, it is true, demonstrate the significant fact that on such a live problem as the fluctuations of general prices, Marshall had in 1887 pointed to one possibility at least of remedial action which is actively advocated to-day. They show the vivid and informing interest in practical questions, such as the housing of the poor, the prevention and adjustment of industrial strife, and co-operative production, which was the outcome of the dominant ethical motive prompting his first entry on, and inspiring throughout his later devotion to, economic study. That motive receives a new and just emphasis in the recollections of the first part, and is echoed in the letters of the third part, of this book. Together with this correspondence the articles reprinted also explain more completely why, democratically inclined as he was in politics, he could not adopt collectivist extravagance which ignores the abiding strength and wholesome stimulus of individual enterprise; and they corroborate the tempered conservatism which made him jealous for the adequate recognition of the useful work done by the older economists when it was liable to be unduly depreciated by later reforming critics. But much of all that is offered to us here, though we would not willingly have forgone the opportunity of extending as well as renewing our acquaintance, was not unfamiliar, and we remain convinced that the *Principles* will be, rightly, the book by which he will be longest remembered.

It has been lately said that he was eclectic rather than original. But, by the apt display of a catholic spirit in the *Principles*, he won a result which before seemed impossible. The keynote of the book may be described as unity, and the Latin motto on the title-page laid stress on development. It was refreshing and encouraging, at that time especially, to discover that the best products of the older writers need not be discarded to make room for the promising output of the new; and wise selection could hardly be parted from original creation, under Marshall's ingenious convincing treatment. For example, was it not more than eclectic to construct a comprehensive theory of value, laying exclusive stress neither on supply nor on demand, but exhibiting instructive analogies between the dominant

forces on either side—the cost or expenses of production in which Mill and his predecessors, and the final or marginal utility in which Jevons and the Austrians, had found the regularity of action desiderated in a scientific law? There was at least originality in showing so conclusively how this theory, accomplishing unity for itself, could unify, through successive development, departments, separately handled before, of distribution and exchange. Accompanied as this was, not to mention other changes, by the treatment alone of the rent of land as “one species of a large genus,” Marshall’s work could not be equitably labelled other than original, even if this seminal notion was discoverable earlier, while its systematic development was his later contribution. At any rate, the *Principles* marked an epoch in the history of economic theory, because they closed the breach between what had gone before and what had followed after and, re-introducing unity, noted and exhibited the pervading presence and dominant influence of continuity throughout the whole range of economic behaviour. That was their *leit motif*; and here it is unnecessary to follow it further into its various manifestations.

But it should be added that in the opinion of the present reviewer, and in conflict with some remarks in other quarters, which can be heard in this book, Marshall showed his judgment and consulted the best interests of economic study by his relegation of mathematics to the background. One who is not a mathematician is, of course, unlikely to be prejudiced in their favour; yet it seems, in his view, a serious drawback, and no advantage, that difficult technique which can only be safely manipulated by the expert should frighten plain citizens away from forbidden trespass on forbidding ground. But, apart from this, the mathematical instrument is confessedly limited in its application, while the danger is imminent that users may overstrain, or overestimate, its potency. We are not sure that Marshall himself read the position rightly, and that he was not responsible for some resulting harm when he laid reiterated stress on the infancy of the economic organon, with the prospect of later maturity, helped, we gather, by appropriate statistics. We are certain that the *Principles* as they are, with mathematics excluded from the text, constituted a great step forward in the development of economic thought. Their significance is only made more manifest by these Memorials, and it would have been very unfortunate if they had been a closed book for non-mathematical readers, or for the “man in the street.”

L. L. P.

2.—*Nationalökonomie und Statistik*. Eine Einführung in die empirische Nationalökonomie. Von Dr. Rudolf Meerwarth, Mitglied des Preussischen Statistischen Landesamt, a.o. Professor der Staatswissenschaften an der Universität Berlin. xii + 506 pp. Berlin and Leipzig: Walter de Gruyter & Co., 1925.

Economic statisticians are already indebted to Dr. Meerwarth for his *Einführung in die Wirtschaftsstatistik*, published in 1920. In his new book he again makes a substantial contribution to the

literature on the subject. Covering a wide range of problems, he discusses with characteristic thoroughness their technical details, thus helping the economist to avoid many a pitfall in which the path of research so dangerously abounds. The volume contains a great wealth of useful information on the sources and the presentation of statistical data on occupation, industry, agriculture, foreign and internal trade, prices, wages, incomes, etc., enabling the economist to trace the origin of the figures he uses and to avoid many fatal errors of interpretation. In this respect its 500 odd pages are evidence of immense industry and constitute a valuable reference-book for anyone embarking on economic investigations based on statistical sources.

Dr. Meerwarth's new book purports, however, to be an introduction to empirical economics, which it certainly is not. Indeed, in his preface, the author actually reduces its scope to that of a treatise on economic statistics by saying that the book is intended to enable the economist to form a critical judgment on the statistics he uses, thus practically waiving the commitments implied by the title. Hardly one-tenth of the volume deals with the problems indicated in the sub-title, and that rather superficially. Of empirical economics Dr. Meerwarth has little to say, and, so far as the reader can infer from his references to the subject, his *empirische Nationalökonomie* is as old as political economy itself, or rather older, since it consists of the use of numerical data and illustrations by which economic writers have been wont to prop their constructions from time immemorial. Generally, his attitude towards the use of modern statistical methods in economic research can best be described as that of a die-hard, rejecting all the expedients by which modern statistical science forces dumb series of figures to disclose their secrets. While he strongly insists on the quality of the data and on their being put to their right and proper uses, he holds that no useful purpose can be served by the comparison or mathematical treatment of the series. This attitude of mind is evident throughout the whole book; it crops up conspicuously in his treatment of the problem of prices and index-numbers, but it is to the concluding words of his last chapter, dealing with the problem of statistical economics, that he reserves its most succinct expression. In discussing the work of the Harvard Economic Service, Dr. Meerwarth sees its only merit to be in its contribution to the *möglichst exakte Darstellung des tatsächlich Erkannten*. "The accomplishment of this task," he proceeds, "can be described as the essential purpose of statistical economics. In any case, however, statistical economics must remain part and parcel of empirical economics. Anyone who, in attempting to build statistical economics, tries by means of comparing series to discover causal relations between economic phenomena or to establish a basis for the prevision of future developments, builds on sand" (p. 500).

Now, by statistical, as distinguished from empirical economics, Dr. Meerwarth understands all economic research conducted by

means of modern, and especially mathematical methods, among which the method of correlation holds a particularly conspicuous position. Many economic statisticians, irrespective of the views they hold on questions of detail, will probably share the reviewer's disappointment at the short work the author makes of what appears to be one of the most promising developments in modern economic science. Indeed, the rapid progress of statistical theory and of its application to the investigation of economic problems would appear to support the view that, alongside with pure economic theory, historical and practical economics, there is gradually growing up a new branch, essentially empirical in its methods, which may be called "statistical economics." In fact, it may be called empirical economics *par excellence*, since the very nature of economic phenomena makes statistical inference, based on probability and the Law of Great Numbers, the only alternative to abstract reasoning in the solution of many a problem and the only possible foundation of scientific empiricism. Neither history nor the use of undigested statistical data, which both allow of an indefinite variety of interpretation, can serve as a basis for scientific empirical economics. The new branch is still in its infancy, and there is a good deal an authoritative writer may have to say to clear ideas and to help in fitting it into the general framework of Economics. This is precisely the kind of work one would expect a German economist to undertake. In taking up Dr. Meerwarth's book one hopes to see these expectations fulfilled, but only to be disappointed. No gospel can be preached by an agnostic, and the author of the *Einführung* is one, in so far as his subject is concerned. Throughout the whole book one sees the hand of a technical expert, fondly hovering over every minute detail of his craft, but either unwilling, or unable, to rise to a height which would enable him to survey the whole field and to attack the broader issues suggested by his title. With a great deal of useful technical information the volume combines a sad lack of constructive ideas. A real "Introduction to Empirical Economics" still remains to be written.

G. A. P

3.—*Statistics and their Application to Commerce.* By A. Lester Boddington, F.S.S. Third edition. 350 pp. H. F. L. (Publishers), Ltd., 1925. Price 12s. 6d.

Since its review in the *Journal* (March, 1922, p. 302) this book has run into a third edition, with an increase in matter and also in the size of the type. On the descriptive side there have been added chapters on "The Census as an Aid to Scientific Business," "Business Research," and "Mechanical Aids to Statistical Work," and on the numerical side a chapter on the measurement of dispersion and skewness. In addition, the section on correlation has now been completed by a description of the method of measurement, the whole now forming a chapter to itself; while to the chapter on index-numbers has been added a description of the latest chain base numbers of the Board of Trade and the *Financial Times* [Mr. Norman Crump]. Finally a certain amount of co-ordination has been carried

out, the whole of the final chapter, on "Published Statistics," which was rather redundant, having disappeared.

"Figures themselves cannot prove anything. It is the method of presenting and using them which results in correct or incorrect conclusions being drawn." In spite of the generally admirable manner in which the author has kept to this principle he has certainly nodded once or twice. Thus, in regard to the weighted average, he points out that the reason that an error in the weights tends to be much less serious than a corresponding error in the size of the items is that "an error in the weights, if many of them are used, will in all probability be unbiassed, and so tend to cancel or nullify one another." But this is nothing less than false reasoning. The errors may be biassed in both weights and items, or unbiassed in both, or biassed in one and unbiassed in the other, and the true reason why an error in the weights is so much less serious is that the weights appear in both numerator and denominator, so that an error appearing in a weight in the numerator is balanced to some extent by the same error appearing in the denominator, whereas an error in an item only affects the numerator. Again, on p. 66 there is an illustration contrasting biassed and unbiassed errors, in which the unbiassed errors happen to be all in the same direction, and, therefore, could equally well serve for an argument based on biassed errors, showing that this type of demonstration is altogether fallacious.

It is unfortunate that throughout the chapter on the measurement of dispersion and skewness no direct verbal indication is given as to when the individual deviations concerned are to be taken without regard to sign and when with regard to sign. Such classic constants as the first and third moments are used in connection with deviations without regard to sign when, as is well known, general statistical practice confines their usage to deviations taken with regard to sign, and if names be necessary other names should be used for other processes. The use of the word ratio on p. 65 would be far better replaced by a percentage accompanied by the number on which it is based. The correlation coefficient continues to be assigned to Pearson instead of Galton, and it is a pity that the terms "Normal Curve of Error" and "Normal Frequency Curve" should be used for any general bell-shaped curve when general statistical practice has assigned a very special meaning to these terms.

Misprints are few and obvious, except that "historigrams" for "histograms" on p. 159, and "butter" for "rubber" on p. 260, might be misleading, while "and meat" should be added after cereals.

H. L. T

4.—*Om Seksualproporsjonen ved Fødselen*. Dens Typer og disses variasjoner med særlig henblikk på fosterdødeligheten av Ingvar Wedervang. xviii + 438 pp. Oslo: Steenske Forlag, 1924.

The literature of the sex-ratio problem is so scattered that an occasional bird's-eye view of the subject is welcome.

The main plan of the present work is one which was suggested by Tschuprow in 1913 in a paper* which threw much new light on the question. This plan is to take as a working hypothesis that all variations in the sex ratio at birth may be due to ante-natal mortality, and to see what evidence can be found to support this in the cases where typical differences in the sex ratio can be traced. This point of view was entirely neglected by many of the earlier writers, though its importance was first pointed out by Christian Bernoulli in 1840; it has since received some attention from different writers with regard to particular problems, and especially detailed treatment by Tschuprow, but hitherto no comprehensive examination seems to have been made.

The work begins with a critical historical survey of some 120 pages of the theories and material of earlier writers, with many numerical extracts. It is to the author's credit that he insists on the need for the statistician and biologist to keep in touch with each other's work, though the short summary that follows of the chromosome theory of the mechanism of sex-determination appears (if an outsider may venture an opinion) to be a somewhat crudely cut-and-dried statement of what is really a difficult question in which much still remains to be cleared up.

The collected evidence for Siegel's twofold theory of the effect of the stage of the menstrual cycle at the time of conception leads Herr Wedervang to accept the theory as regards varying probability of conception, but to conclude that the influence on the sex ratio has not been statistically demonstrated. The sex ratios at different ages of living populations, as actually observed in recent times, are contrasted with those deduced from life-tables, on the assumption that the disturbing influence of migration is removed; the latter illustrate the fact that, on the whole, without migration there would be a male excess at marriageable ages in most European countries. Though it is frequently observed that the legitimate sex ratio (males/females) is higher than the illegitimate, the author points out that this cannot be set up as a general rule for all births, though it is on the average true for stillbirths.

The main thesis of the book is then approached, and, as a basis, the available figures for premature births, stillbirths and abortions—incomplete as they are—are treated in detail. The course of the ante-natal mortality previously described is supported by later figures. The death-rate decreases with increasing age of the embryo to a minimum in the seventh and eighth month of pregnancy, and then increases sharply, to decrease again in the early stages after birth, thus indicating three different phenomena—the true intra-uterine death-rate decreasing with each month, a death-rate determined by the shock of birth, and a death-rate measuring the risks to the infant's separate life. The corresponding sex ratio of deaths shows a somewhat similar course, being considerably

* *Bulletin de l'Institut International de Statistique*, tome xx, 2ème livraison, pp. 378-492.

higher for abortions at the earliest stages, decreasing to a minimum in the seventh and eighth month and then again increasing. By an approximate calculation the original sex ratio is roughly estimated at not less than 134, and that for all ante-natal deaths at about 462, values which do not differ much from similar minimum estimates made by Tschuprow on partly different data.

Twin-births, age of parents, including the Hofacker-Sadler theory and its conflicting successors, and order of birth are the chief special questions studied in the light of such official statistics as exist for ante-natal mortality. Some of the results are familiar but strengthened by fresh material, others are new. For instance, the author gives figures to show that not only do both sexes among mixed twins have a lower stillbirth-rate than the same sexes among like twins, but that even the boys among mixed twins have an advantage over the girls among like twins; and also traces a differential stillbirth-rate between like and unlike twins according to the mother's age, hence concluding that the higher percentage of mixed twins found with increasing maternal age and with birth order is not due to the chance for simultaneous fertilization of two eggs increasing with age and repeated child-bearing, but to the fact that among the like twins, those arising from a single egg have lower viability, and are therefore more often aborted at an early stage.

With regard to the parents' age, the only general tendency that can be traced—and that, it may be noted, is by no means universal—a sinking sex ratio with increasing absolute age of the parents, is attributed to a higher death-rate at an early stage of pregnancy the older the mother is; while the fact that the connection comes out rather more clearly with the father's age (though in this case only an indirect one) is ascribed to the disturbing influence of the stillbirth-rate, which undoubtedly increases with advancing age of the mother; and to the latter cause also is charged the tendency pointed out for the sex ratio to be higher in marriages where the mother is older than the father.

It is obvious from the many deficiencies in the data that no very clearly defined associations are to be expected. To mention one difficulty only, the argument has often to depend on a presumed correlation between high stillbirth-rate and high abortion-rate. That this correlation need not always exist is suggested by the typically heterogeneous form of the prenatal death-rate curve, and an example is afforded by firstborn children, who appear to owe their relatively high sex ratio to a lower abortion-rate, in spite of being more prone to stillbirth than those next in order.

We may be one with the author as to the importance of ante-natal happenings for the sex ratio at birth, without agreeing to his dictum that because the latter is a "resultant-type of ikke en natur-eller grunntype" (can we, incidentally, lay our finger on *any* measurable biological or natural characteristic that is not in some sense a "resultant-type"?), therefore the theory of probability

is of little use in weighing its deviations, and that since the fundamental proportion is unknown, estimates of stability of the sex ratio at birth based on the mean square error, etc., are of little value. Such a conception of the field of probability is too narrow to commend itself to most statisticians. It would have added to the value of this book if the author had in some cases applied tests of the reliability of the tendencies traced, especially as a reader can as a rule only apply such tests if the data are given in fuller form than the cost of printing allows. He does, however, show a sound statistical sense of caution in dealing with his figures, and has his eyes open to the many pitfalls latent in the material. The book is a useful and interesting contribution to the study of the sex ratio; it contains a large compilation of numerical material, both old and new, chiefly from official sources, and deserves to be studied in detail. A short summary in English is provided (is it ungracious to suggest that this might with advantage have been submitted to an English proof-reader?). This allows the main lines of the argument to be followed, but necessarily omits much of value and interest, and is also more dogmatically expressed than the complete text. Though the author may fairly claim to have shown that the effect of ante-natal mortality is large enough to account for all observed variations in the sex ratio at birth, without assuming any but chance variations in the original sex ratio, and that in certain cases strong but indirect evidence of a real association can be traced, this does not justify the categorical assertion that "all variations of the proportion of sex are due to oscillations of the frequency of stillbirths and abortions."

E. M. N.

5.—*Economics of Business Cycles.* By Arthur B. Adams, Ph.D. xvi + 268 pp. London: McGraw-Hill Publishing Co., Ltd., 1925. Price 12s. 6d.

Much pessimism has undoubtedly been caused by the promulgation of the doctrine of inevitableness of sequences of cycles in economic conditions. It is refreshing, therefore, to find in Dr. Adams' book a notable exposition of the theory that economic cycles may be independent events, and that, while the happenings in one cycle flow naturally from one origin, the cycle is not necessarily the result of previous cycles and does not necessarily give rise in its turn to a continuous and relentless sequence of similar cycles.

The subject is treated analytically, and the author gives concrete examples only to illustrate the existence of business cycles as such. To have proceeded otherwise would have meant considerable enlargement, and would certainly have involved some loss in directness of argument and in lucidity.

Following the usual practice, a business cycle is considered as composed of four periods: prosperity, crisis, depression, recovery. Once the period of prosperity is initiated by the rapid upward movement of prices and the availability of the necessary credit,

Dr. Adams holds that the rest must follow. But in his opinion the initiation of prosperity is not a natural outcome from the period of recovery; it is generated then only if there is some special operating factor, *e.g.* war, new exploitations of natural resources, inventions. Apart from cycles and general secular trend, economic conditions are in a state of rather small oscillations about a position of equilibrium.

Dr. Adams devotes an interesting chapter to summarizing and criticizing other important theories of business cycles. He also deals with possible controls of the cycle by private or public means. His conclusions are not unhopeful, but he feels that the most promising method lies in the restriction, by prior Government enactment, of commercial credit during the period of prosperity.

The book is eminently readable.

A. Z.

6.—*Monetary Stability*. By J. R. Bellerby. xvi + 174 pp. London: Macmillan, 1925. Price 7s. 6d. net.

The keynote of reform in monetary science was struck by the International Economic Conference at Genoa, 1922, when it envisaged a common standard—that of gold—and the maintenance of the value of each country's currency, expressed in gold, at a stable level, if the economic reconstruction of Europe was to be achieved. In other words, the value of gold, that is, its purchasing power over commodities in general, must be stabilized. As the Conference said, the object would be to centralize and co-ordinate the demand for gold and so avoid wide fluctuations in its purchasing power. Since these dicta were pronounced, the world has learned by bitter experience the power of the monetary factor in its economic problems.

Mr. Bellerby has built his book on these foundations. As he rightly points out, the policy of stabilization is already being tested in practice. The Federal Reserve Bank in the United States is, not avowedly, it is true, but none the less clearly, experimenting with the regulation of credit policy in such a way as to avoid restraining legitimate trade expansion, whilst at the same time eliminating undue speculation. If this policy is to be extended and followed in other countries, central banks must have a clear conception of their aim. Mr. Bellerby contemplates two alternative systems of price stabilization, and his essay is devoted almost entirely to an examination of their respective merits. Under his first method a definite level of prices—definite, that is, as already existent at some chosen time—would be adopted as the normal level. The policy would then be to hold the price-level at all times as nearly as practicable to that norm. Alternatively, no fixed normal level would be selected and the price-level would be allowed to experience long-period or secular movements. All that would be attempted would be to check short, sharp and abrupt movements whenever the authorities that be regarded them as unhealthy. In each case the main instrument of control would be the rate of discount, and the barometer to be watched would be the economic indices of prices, employment

production, etc. The relative advantages of these alternative methods of stabilization are then examined under six heads, viz. :—

- (i) Ease of application.
- (ii) Effect on total long-period consumption.
- (iii) Relationship to current conceptions of social justice.
- (iv) Influence on industrial and social relations.
- (v) Expediency from the international standpoint.
- (vi) Expediency in relation to the Genoa Resolutions for a gold-exchange standard.

Mr. Bellerby concludes that the fixed normal price-level emerges on balance from these tests as the preferable method. His view rests, as the ultimate case for stabilization must rest, on the test of social justice and the influence of the price-level on industrial and social relations. He bolsters his position on error, however, when he suggests that the private investor is unable to protect himself against currency depreciation when lending to a foreign government in terms of that government's currency. Surely the normal course is that a borrowing government floats its loans in the country where it seeks them in terms of the lender's currency. It follows that the risk of the investor is a risk of movement of value in his own currency, and that is one which investors are usually ready to take. Mr. Bellerby does not perhaps emphasize sufficiently the difficulties of international agreement in any sphere, and especially in the intricate sphere of finance. It may be, as he says, that "the only policy which will be capable of giving general satisfaction will be that which . . . is capable of clear definition." Unfortunately, "clear definition" is the one thing which seems almost unattainable when formulating a policy of stabilization. The use of indices of economic welfare is as yet an undeveloped science. Movements, whether regular or irregular, of the immediate past are hard to interpret, and present action designed to influence future events must often be taken largely in the dark. In real life the actual price-level is the resultant of very numerous factors, often disconnected, as a result of which fluctuations will never be eliminated. It is with these minor movements, and particularly with the movements of the prices of separate commodities, that the business world is most concerned. A policy of stabilization must at times provoke much criticism for this reason. The unique position of the Bank of England compared with other central banks is not discussed, nor is the ultimate responsibility of the State as the representative of the community adequately dealt with. Can the immense power contemplated be entrusted to a private concern, of which the virtual executive head may change from year to year? As the public welfare is undoubtedly concerned, can the State ignore its responsibility? If gold is to be stabilized in value, a surplus stock must be maintained. The uneconomic expense arising will fall primarily on the central banks, but as this charge is one incurred in the public interest, must it not properly fall upon the State? There

is, however, much distrust of State interference, with its risk of political bias. How to eliminate these difficulties is the real problem of stabilization. Mr. Bellerby throws little light on it.

Stabilization will be a plant of slow growth, but the stream of literature on the subject should encourage study, and Mr. Bellerby's book should be welcome to those whose thoughts are first turning to this difficult but fascinating subject.

W. H. C.

7.—*Financial Reconstruction in England, 1815–22.* By A. W. Acworth. 158 pp. London: P. S. King, 1925. Price 8s. 6d. net.

This book is a very good example of how economic history ought to be handled. It is full of facts, but is not overloaded; for the facts are given significance by being brought into relation with economic theory.

Humanity cannot hope for wisdom except through experience, and it is the function of the historian to interpret experience. It is possible to learn from distant times and places and from conditions apparently quite different from our own. Mr. Acworth's theme, however, gains interest from the fact that it is by no means so remote. It furnishes, indeed, in many respects a striking parallel to the present post-war problems. He has, as he says in his preface, "refrained from pointing comparisons or contrasts with the events of the last seven years," but comparisons and contrasts readily suggest themselves to the reader.

They had their capital levy controversies in those days, free from the taint of socialism, and even from the complication of graduation.

Mr. Acworth gives a clear and interesting account of the notorious sinking fund established by Pitt. He brings out an aspect of the matter which has escaped the notice of other writers. The sinking fund was applied to the redemption of funded debt, and the fresh borrowing by which alone it could be kept supplied often took the form of additions to the floating debt. It was, therefore, not merely futile and a source of loss, but at times was an inflationary influence.

Herein Mr. Acworth finds the explanation of the set-back in the value of the currency after 1816. In the two years 1816 and 1817, "in effect the Government paid off some £12 millions (nominal) of Funded Debt by borrowing notes from the Bank of England to the required amount."

Naturally the resumption of gold payments occupies a large part of the book. Some account is given of the proposals for a "managed" currency, particularly of Thomas Attwood's, and then we come to the actual legislation of 1819, embodying Ricardo's ingot plan. Mr. Acworth shows that the plan was not in the event carried out. Whatever the Act of 1819 said, "it lay with the Directors of the Bank of England, a body of men that Ricardo did not trouble to placate, to make or mar the ingot plan."

The essence of the plan was to economize gold by abstaining from the use of gold coin in circulation, but to maintain gold parity by the sale of gold bullion for export. But there was *no* economy of

gold. Gold poured into the Bank of England in unprecedented quantities, and in less than two years gold coin was being issued rapidly into active circulation under the amending Act of 1821.

The explanation was that the Bank of England "refused to discount at a lower rate than 5 per cent. Since in 1820 prices were steadily falling, a money rate of 5 per cent. was equivalent to a much higher real rate, and was effective in choking off borrowers."

Ricardo protested bitterly against the Bank's accumulation of gold. The Prime Minister, Lord Liverpool, speaking in 1822, not only protested against the 5 per cent. Bank rate, but actually proposed to borrow £4 million from the Bank in order to counteract its injurious effects. Here was open opposition from the Government to the Bank's deflationism.

"The only adequate explanation of the Bank Directors' extraordinary conduct," says Mr. Acworth, "is that suggested by Ricardo—that they 'did not understand the subject of currency.'" He quotes Ricardo on the Directors: "If their object had been to make the revulsion as oppressive as possible, they could not have pursued measures more calculated to make it so than those which they have actually pursued. Almost the whole of the pressure has arisen from the increased value which their operations have given to the standard itself. They are indeed a very ignorant set." R. G. H.

8.—*The Financial Crisis of France.* By the Hon. George Peel. ix + 323 pp. London: Macmillan & Co., 1925. Price 10s. 6d net.

To present and criticise in a short, attractive and readable form the multitudinous and intricate facts of such a portentous financial crisis as has persisted for years past in France is something of a literary achievement. Mr. Peel's book is first-rate journalism.

Unfortunately it was planned to culminate in the return of M. Caillaux to politics. "There was a trunk call on the telephone. The capital rang up Marnes. A voice answered. There was a moment of hesitation, and then the voice replied 'Je marche.' Quickly a big grey car set forth eastwards for Paris. An exiled statesman was coming back." The "Future of French Finance," described in the concluding chapter, is the future proposed for it by M. Caillaux. The Caillaux episode having been terminated in anticlimax since the book was written, some of the savour has gone out of Mr. Peel's literary dish (unless M. Caillaux returns).

Still it would be a mistake to suppose that the value of the book depends upon this personal touch. The author has endeavoured to give a just picture of the causes and present features of the French financial *impasse*. A great part of what he has to say is well and fairly set out. The weak point of the book from the economic and financial standpoint is that it contains no clear conception of the relation of finance to currency.

Mr. Peel's account of the causes of the crisis is incomplete. "Having to spend so much on restoration, and having got nothing from Germany, France had to go on borrowing." The deficits

of five years came to 150 milliards. "During 1923 the franc began to fall seriously," and it "fell catastrophically to nearly 120 to the pound in March, 1924." "The real cause of the sudden fall in the franc was that . . . the French people, after nearly a decade of lavish lending to their own Government, showed distinct symptoms of being averse to lending any more."

All this is quite right as far as it goes. But Mr. Peel nowhere makes clear that France had already passed through a severe currency crisis in 1919 and 1920, which brought the Exchange down from 18.3 cents (U.S.) in March, 1919, to 6.2 cents in April, 1920. That situation greatly adds to the significance of the tax reforms of June, 1920. "This effort of 1920," says Mr. Peel, "was the most considerable that France had ever made in a single year." The crisis ended, and then ensued deflation, assisted without doubt by the tremendous deflation in progress in England and America. The monetary recovery which, by February, 1922, had brought the exchange up to 9 cents, and reduced the price index to 306, as compared with 588 in April, 1920, was the secret of the favourable market for Government borrowing in 1921 and 1922. Mr. Peel attributes the low price of French Government securities in 1924 to the exchange "rendering the value of the franc so doubtful in the future," but he fails to observe the contrary application of the corresponding principle in the period of the appreciating franc. The appreciation of the franc in 1920-2 enabled the Government to borrow successfully, but it weakened the financial position in another direction, in that it diminished the productivity of the new sources of revenue. Mr. Peel recognizes the effect of a fall in the franc in lightening the burden of the debt, but curiously enough seems to think that this does not apply to the short-term debt (p. 5). This lightening of the burden is felt in the form of an increased nominal yield of the revenue in francs to meet a debt charge fixed in francs. (It may be necessary, it is true, to pay a higher rate of interest on the floating debt, but only while prices are *rising*, not after the rise is over.)

The borrowings required after 1922, though still large, were far less than in 1919 or 1920. It is not certain that, if the franc had remained stable, the whole could not have been financed with genuine savings.

Mr. Peel does not consider the situation as it was in 1922, when the worst of the post-war financial troubles seemed to be over.

The renewed fall in the franc did not begin in 1923. The exchange was weakening in July, 1922, and by November it had already fallen below 7 cents, and prices were leaping up. The cause was not in the budget or the loans or the Bank of France; it was *political*. The passage from an exchange of 9 cents and a price index of 306 in February, 1922, to an exchange of 4 cents or less and a price index of 500 in February and March, 1924, coincides with the Ministry of M. Poincaré.

Of that reign of hostility, violence, bitterness and distrust

Mr. Peel has little to say. It culminated in the failure of the Crédit National loan of January, 1924, but he is content to record the reluctance of the French investor, without seeking for an explanation. That reluctance was simply the natural consequence of the steady decline of the franc, which had already touched 5 cents at the end of 1923.

Before he left office, M. Poincaré had already adopted remedial measures. The appointment of the Dawes Committee in November, 1923, opened up the prospect of a settlement of Reparations. Credits arranged in London and New York provided the means of supporting the exchange. Taxes were substantially increased.

The support of the exchange proved too effective. The franc jumped up from a minimum of $3\frac{1}{2}$ cents in March to over $6\frac{1}{2}$ cents in April. The Bank of France was precluded from selling francs to keep the exchange down by the statutory limitation of its note issue. The advantage that might have been obtained from a stabilization of the franc at a manageable figure, say, 5 cents, was sacrificed.

The distrust of the franc was not removed, perhaps not even alleviated. It was felt in the sensational fall in the price of rentes and in a growing danger from the floating debt. Mr. Peel pours scorn on M. Clémentel's not very fortunate experiment of a "taxes cheque," which enabled the taxpayer to secure a discount as high as $8\frac{1}{2}$ per cent. per annum by paying in advance. His criticism is that this instrument would compete with the existing floating debt, which yielded only 5 per cent. He does not raise the question whether in such conditions it was wise to peg the floating debt at a fixed and low rate of interest. (The rate was high according to ordinary standards, for the interest was tax-free, but was low in relation to the state of the capital market.) It is remarkable that the French Government has never adopted the plan (which we in this country returned to in 1921) of selling bills at whatever rate would raise from the market the funds needed to maintain balances.

The French crisis is, and has been since the beginning of 1924, a floating-debt crisis, arising from distrust of the franc. A severe fall in the franc "could not fail eventually to upset the all-essential confidence required from the holders of the short-term and floating debt, who might, if they lost faith, take the course of failing wholesale to renew." Distrust of the franc precluded funding. Mr. Peel quotes M. Caillaux: "rien à faire tant que le franc ne se sera pas stabilisé."

To balance the budget is ultimately a necessity, but for the time being it is a secondary matter. The deficit may be some milliards; the floating debt is nearly 100 milliards. Such restoration of confidence as will keep the floating debt afloat would enable the Government to take several years' deficits in its stride.

It is amazing that Mr. Peel never refers to the gold reserve of the Bank of France, except to quote M. Clémentel as saying that

"the whole credit of the State rests finally on the gold in its Bank of Issue," and that the use of the gold as security for the Morgan credit was an "acute danger for the whole country." What is a gold reserve for? When the entire economic fabric of a country is threatened with collapse owing to distrust of the currency, is the gold to remain unused? The credit of the State does indeed rest on the gold, but that means that the credit of the State cannot surpass that of the currency unit in which its obligations are expressed. The function of the gold is to support the currency unit. If it is not used for that purpose, it might as well not be there. When Mr. Peel was writing, the gold in the Bank of France was worth at current rates about 15 milliards. Yet he leaves it out of account!

A considerable part of the book is taken up with an exposition of French taxation, starting with remote history. The meagre yield of the income tax is well and concisely discussed. It is rightly pointed out that the low yield from the schedule relating to land, buildings and agricultural profits, is not due to evasion, but to the system of assessments, based on pre-war *documents cadastraux*. Mr. Peel seems to take almost too calmly an income tax which treats 9½d. as if it were 2d. On the other hand, he omits to mention that the assessments are to be revised—in a few years.

In dealing with taxation he makes a passing reference to national income. Taking the very sketchy estimate of 125½ milliards from M. Clémentel's *Inventaire*, he puts the ratio of tax revenue to national income at 16 per cent. for 1923, and says that the ratio "is tending to increase in France to the extent of 20 per cent. to-day." He is forgetting, however, to allow for the effect of currency depreciation on the national income. M. Clémentel, it is true, assumes the same figure for 1924 as for 1923, but the *Inventaire* was composed when the year 1924 was still incomplete. The price index rose from 418.9 in 1923 to 488.5 in 1924. Since Mr. Peel wrote, it has risen above 600. M. Clémentel's estimate was a low one. Mr. Findlay Shirras's estimate for 1924, given in the paper read to the Royal Statistical Society in June, 1925, was 164 milliards. R. G. H.

9.—*Wealth and Taxable Capacity of India*. By K. T. Shah, Professor of Economics, University of Bombay, and K. J. Khambata, M.A. xxi + 347 pp. Bombay: D. P. Taraporevala; London: P. S. King, 1924. Price 15s. net.

The Wealth of India. By P. A. Wadia, Professor of Politics and History, Wilson College, Bombay, and G. N. Joshi, Lecturer in Economics, Wilson College, Bombay. xi + 438 pp. Macmillan, 1925. Price 21s. net.

We confess to a certain difficulty in following Messrs. Shah and Khambata. In a subject that pre-eminently demands simplicity and coherence of reasoning and breadth of treatment we are confused and overwhelmed by voluminous masses of detail, diffuseness of style and irrelevance of argument. It should not require fifty-seven

pages to explain what is meant by national wealth, and the authors' decision to exclude non-industrial services from the reckoning of the national income is distinctly a step in the wrong direction, for, rightly or wrongly, the community puts an independent value on the exertions of this class of persons and allows them to participate in the general share-out on precisely the same terms as any other class. The authors should also have been more careful in defining the scope of their enquiry, for it is very confusing to find that part of the book refers to India as a whole and the rest to British India only. However, much of the difficulty appears to arise from divergencies of view between the authors, and this admission disarms some of our criticism.

We have managed to disentangle and summarize a few results. Valuing current production at representative wholesale prices, the net output of Indian agriculture and industry was worth Rs. 2,364 crores (Rs. 74 per head) for the year 1921-22 and Rs. 1,106 crores (Rs. 36 per head) for the years 1900-14; and allowing for the fall in the value of money, the real wealth of India in recent years is about 10 per cent. greater than it was before the war. The drain of wealth abroad is estimated at Rs. 220 crores for the post-war period, and after allowing for all charges upon the national wealth, the producer class get Rs. 1,600 crores, or about 66 per cent. of their gross production. Average income is said to be just sufficient to feed two people out of three, without providing for any other needs whatever, and more than one-third of the national wealth is enjoyed by 1 per cent. of the population.

The book is well documented and shows the marks of immense patience and industry. It is regrettable that its mode of presentation leaves so much to be desired and that its conclusions are not summarized in a more intelligible form.

Messrs. Wadia and Joshi's book is modelled on a different pattern. The authors aim at ascertaining and surveying the factors—actual and potential—which contribute to the production, distribution and consumption of wealth, and the result is an interesting and readable, though rather sketchy, account of Indian social and economic conditions. India, they conclude, is beginning economic life at a stage passed by Europe three-quarters of a century ago, and to profit by this experience needs the enunciation of a clear economic policy, for Indians must shake themselves free from the prepossessions of a commercial age and think in terms of the men and women for whom their social and national institutions exist.

The book is mainly non-statistical, but there is an estimate of the national income, giving Rs. 1,210 crores for British India in 1913-14, or, deducting Rs. 123 crores for drain of wealth abroad, a net income of Rs. 1,087 crores (Rs. 44 per head). No estimate is given for the post-war period. The productive power of India is remarkably low, the majority of the people have to live at starvation rates, and with all available surplus produce drawn away to meet the dividends of foreign shareholders and the expenses of

administration, the authors think it perversity to speak of the retardation of industrial development.

The estimates of national income given in these two books are consistent with one another, but there is reason for suspecting that they are far too low. When the vast majority of the population are below the income-tax level and there is no census of production available, two of the most useful sources of information as to national income are closed. Fortunately the land revenue system involves the collection of comprehensive agricultural statistics, and the valuation of crop production at current wholesale prices, plus an estimate for non-agricultural income, affords a convenient makeshift. Price statistics are, however, unreliable and, there being no independent check on results, there are unlimited possibilities of biased error. In this connection the estimates given by Mr. Findlay Shirras deserve special attention, both because of the care with which they have been compiled and because of the author's reputation and experience in Indian affairs. Mr. Shirras gives for British India, Rs. 2,866 crores (Rs. 116 per head) for the year 1922 and Rs. 1,942 crores (Rs. 80 per head) for the year 1911, from which figures we should deduct Rs. 198 crores and Rs. 141 crores respectively for seeds and manure. Considering that the actual standard of living obtaining in British India corresponds to an expenditure of Rs. 2,200 crores after the war and Rs. 1,200 crores before, the Indian authors' estimates are *prima facie* inadequate. Even Mr. Shirras's estimate leaves the margin over subsistence level uncomfortably low and liable to disappearance altogether in a bad year, but it is clear that any arguments based upon the alleged inability of India to feed her people in a normal year need re-examination. L. R. C.

10.—*Currency Problems and Policy of the Soviet Union*. By Professor L. N. Yurovsky, Chief of the Currency Department in the People's Commissariat of Finance, Moscow. 152 pp. London: Leonard Parsons, 1925. Price 7s. 6d. net.

The economic and financial evolution of Soviet Russia presents many interesting problems, but the task of the student is made uncommonly difficult by the practical impossibility of obtaining really trustworthy information, uncoloured by partisan bias. Too much of what is written must be discounted as propaganda, and even *bona fide* publications, at a time when political contention is still rife and shows little sign of abating, cannot avoid some amount of misrepresentation by commission or by omission. It is refreshing, therefore, to find a book, written by an expert, in which the story of Russian currency and finance is told plainly, without the addition of colouring matter or unnecessary theorising. So much can be said of Professor Yurovsky's book, which can well be recommended to those interested in modern Russian problems. The reader will find information on the development of the financial and monetary policy of the Soviet Government from the beginning to the middle

of 1925, contained within the limited compass of some 150 odd pages, with a brief introductory account of the preceding three years, from the outbreak of the war. It is highly interesting to find in the book a short account of the monetary history of the outlying parts of Russia—Turkestan, Transcaucasia and the Far East, of which very little was known before. An interesting chapter is devoted to the attempts made by the Soviet Government to do away with money altogether, making the "labour unit" the standard of value in strict conformity with the Marxian theory of value. Then follows an account of the gradual return to sound currency, after many attempts at making a satisfactory index-number, on which the calculations of the Government and, indeed, the economic life of the whole country, depended for over two years, until the issue in November, 1922, of the *tchervonetz* bank-notes. The *tchervonetz* provided a new relatively stable standard of value, circulating along with the depreciated Soviet rouble. The economic crisis of 1923, in which the *tchervonetz* very nearly succumbed and was only saved by sacrificing the rouble, struck the final blow to the latter, and in the early part of 1924 the Government was forced to complete the reform. The old issue, already practically demonetized, was redeemed for new Treasury notes, whose issue was limited by law to one-half of the total amount of *tchervonetz* bank-notes in circulation at any time. The *tchervonetz* remained the standard of value, the bank-notes circulating along with the Treasury notes, which were issued in smaller denominations. This system is still in force, though it presents certain drawbacks in that a way to inflation is left open by the absence of rigid limits to the Treasury issue. In fact, the more the State Bank increases its issue of bank-notes, which, as was the case in 1923, may occur as the outcome of its commercial policy, the larger is the opportunity of the Treasury to issue notes for Budget purposes: a position which is dangerous indeed. It must, however, be admitted that on the whole the Soviet Government has been successful in its monetary policy. One can only wish that there could be a similar return to sanity in other directions; this would be the best guarantee of the continued stability of the currency. The reader of this short review must be referred to the book for a complete account of the vicissitudes of the transformed rouble and of Russian finance during the revolutionary period.

Professor Yurovsky has done well in thoroughly revising the contents of his book before its publication in this country. The English is considerably better than that usually found in similar publications; the technical terms are generally correct, though objection may be raised to the use of Professor Knapp's "definitive medium of payment" instead of the plain "legal tender": even the most ardent admirers of the eminent German economist would hardly wish his rather clumsy vocabulary to supplant the simpler terms in common use.

G. A. P.

11.—*Has Poverty Diminished?* A sequel to *Livelihood and Poverty*. By A. L. Bowley, Sc.D., and Margaret H. Hogg, M.A. 236 pp., demy 8vo. London: P. S. King & Son, Ltd., 1925. Price 10s. 6d. net.

In 1913 Professor Bowley and Professor Burnett-Hurst carried out an investigation into the economic status of the working-classes in five towns in England. The results of this inquiry (published in 1915 under the title of *Livelihood and Poverty*), which comprised a detailed analysis of the composition of the family as regards wage-earning capacity, number of children and other dependants, and a commentary upon the state of housing, enabled the authors to reach approximate conclusions as to the number of families in poverty—as measured by the number failing to reach a certain minimum standard of livelihood.

In 1924 Professor Bowley and Miss Hogg (with the assistance of investigators in each town) repeated this inquiry in the same towns and as nearly as possible with the same methods. The present book gives an analysis of the data obtained in this second investigation, and compares the conclusions reached in 1924 with those of 1913.

The years 1913 to 1924 have been witnesses of such great changes in the social phenomena of England that such comparison of the position of working-class households in pre-war and post-war days is of peculiar interest. "The dominating events so far as these studies are concerned," say the authors, "have been the fall of the birth-rate, the loss of life by the war, the rise in prices and the more rapid rise of weekly money wages for unskilled labour and unemployment, . . . and there have been no means of estimating how far the changes in wages and in personnel have affected the proportion of persons who are in a condition of poverty."

The method employed, as in 1913, has been to take a random sample of the working-class households of Northampton, Reading, Bolton, Stanley and Warrington, and to ascertain the details required by visit to, and interrogation of, each family, the information especially as to income being often confirmed by reference to other sources. The size of the sample varies from 1 in 8 in Stanley to 1 in 36 in Bolton, giving 800 to 1,000 households in each of the five towns.

The data thus obtained reveal a most remarkable improvement since 1913 in the status of the working-class households.

"Even on the assumption that all the families suffering from unemployment in a particular week [*i.e.* the week of inquiry] had no adequate reserves, and that their unemployment was chronic, the proportion in poverty in 1924 was little more than half that in 1913. If there had been no unemployment the proportion of families in poverty in the towns, taken together, would have fallen to one-third, and of persons to little over a quarter of the proportion in 1913. All the towns, except Stanley, show an improvement in nearly the same ratio."

In Stanley, a mining town, and therefore subject to special

difficulties at this period, no improvement is shown. With regard to the other towns, it must be remembered too, as the authors justly point out, that their conclusions represent an "instantaneous picture," and that many families may pass below the poverty line at one time of life or another. In particular it is stated as regards children that "more than 1 in 6 are in present circumstances below the line at some period of their young lives." In spite of such great improvement there is still much to wish for.

The dominant causes of this reduction of poverty are the smaller number of children per family—consequent upon the fall of the birth-rate—and the increase of wages for unskilled work. In the estimation of the authors the latter cause is about twice as important as the former, but in the week of inquiry "two-thirds of the improvement due to wages was lost . . . owing to unemployment."

The question of unemployment and its effect upon the amount of poverty are discussed in detail.

In the discussion on housing, the authors reach a conclusion of much practical importance to-day—that a considerable proportion of the working-class could afford a higher rent, and that "the housing authorities are too timid to venture and the working-class families too unwilling to devote an adequate part of their income to house accommodation." Actually they found a substantial amount of overcrowding, often due to the presence of lodgers. On the other hand, without the income derived from such lodgers the number of families falling below the poverty line would be increased.

In their measure of overcrowding the authors not only take a standard of more than two *persons* to a room, but in addition have carried out an elaborate calculation of the number of *equivalent adults* per room, counting a child as a particular fraction of an adult according to its age. They state that "the number of persons fails to afford a satisfactory comparative test since in 1924 there were relatively more adults and fewer children than before the war."

This assumption—that a child needs less "room" than an adult—is, surely, questionable? From the standpoint of health a child perhaps needs *more* air space, having normally a less immunity to infectious diseases; and from the standpoint of comfort there seems no justification for giving the adult a larger share of room. It is true that, up to the age of adolescence, less sleeping accommodation is required for children of both sexes, but this alone is hardly a sufficient reason for the statement quoted above.

A point of interest brought out in the inquiry is the extraordinary part played by pensions in modern-day life. In the four towns Bolton, Northampton, Reading, and Warrington, 3,512 families were investigated, and in these there were 503 persons in receipt of a pension. The great majority are Old Age pensions and War pensions—the latter being, of course, only a transitory event.

In the review of *Livelihood and Poverty* in this *Journal* (vol. lxxviii, 1915, p. 455), it was said that "the economic

conditions disclosed make sad reading"; the present volume, though it cannot tell the reader that "all's right with the world," must leave him in a happier frame of mind than did its predecessor.

It is a book which cannot be neglected by anyone interested in social conditions, and still less by anyone concerned in such practical investigations.

A. B. H.

12.—*Family Allowances*. Studies and Reports, Series D (Wages and Hours). No. 13. 186 pp. Geneva: International Labour Office, 1924. Price 3s.

In 1923 the International Labour Office decided to undertake a detailed investigation as to the extent to which family allowances had been introduced in various countries. The University of Chicago approached the Office with a view to co-operation, and agreed to make a grant from its funds to enable the Office to extend the range of its enquiries. The Prefatory Note acknowledges the great value of the cordial co-operation of Professor Douglas, acting on behalf of the University.

In general, only those systems are treated in which the payment of allowances involves a differentiation between the income of the married worker with children and that of the unmarried worker. France and Belgium, where the equalization fund method has been most widely adopted, largely on the initiative of the employers, are given first. Then follow the Central European countries—Germany, Austria, Czechoslovakia and Poland—where the system has been based mainly on collective agreements between employers and workers; collective agreements have also characterized the system in the Netherlands. In Denmark, Norway, Sweden, Finland and Switzerland, and to some extent in Italy, a common feature has been the development of the system during the war years, and its abolition, except in some cases for state servants, when more normal conditions were restored. In Great Britain the principle has been very little applied either during the war or since. The review concludes with Australia, not on account of the adoption of any allowance system but because of the proposals which have been put forward as a development of the doctrine of the "living wage" generally accepted in Australia for many years.

The studious avoidance of tabular statements in the Report, involving long accounts of the statistical impression left on the mind of the compiler, makes much of it tedious reading, and the most important societies in their returns give very little of the kind of information a scientific inquirer needs to know. In France, at the end of May, 1924, there were 151 equalization funds (*caisses de compensation*), covering 9,300 establishments with over a million workers. In the establishments covered by 32 of these funds were employed 526,000 workpeople, including 123,000 heads of families with 213,000 dependants. The latter term seems to include only children respecting whom allowances might be claimed (under

varying rules) and wives not at work. No information is given as to the ages or sex of the workers, nor as to wages paid to them collectively or separately. From the account of proceedings in the Chamber of Deputies in 1920, on the introduction of a Bill, and from the outside criticisms on it, a little information may be gleaned. It was proposed to make compulsory (on the part of employers) the payment of family allowances and membership of an industrial or district equalization fund; the employers were to pay to the fund a minimum of 5 per cent. of the wages paid. A report received in 1921 by the Lyons Chamber of Commerce stated that the proposed subscription was much higher than the average actually paid, which did not exceed 1.6 per cent.

In Germany the statistical returns give much more valuable information in consequence, no doubt, of workers being represented as well as employers. A useful table is given (p. 109), showing the weighted average wage-rates of unmarried and married workers in different occupations and the relation of married to unmarried workers' wages in April and October, 1922, and January and April, 1923.

The sections of the Report giving the opinions, more especially of employers' and workers' organizations, on the system itself deserve careful attention. "Workers' organizations are as a rule strongly opposed to systems of family allowances initiated and controlled by employers."

C. E. C.

13.—*Wages and the Family*. By Paul H. Douglas, Associate Professor of Industrial Relations. xiv + 290 pp. Chicago: University of Chicago Press, 1925. Price \$3.00.

In Part II, entitled "The Family Allowance System Abroad," Professor Douglas covers much the same ground as the I.L.O. report, and acknowledges his special indebtedness to Mr. J. H. Richardson, the member of the Secretariat in charge of the investigation. It is much more readable, partly because the few statistics necessary are given in tabular form, but mainly because the writer expresses himself with greater freedom. The official report confines itself to the statements of expressed opinions. Professor Douglas discusses motives.

Thus, speaking of the French employers, he says: "A humane desire to relieve the distress existing in large families, a wish to help raise the birth-rate and thus at once to protect France more effectively from military aggression and to provide the industries of the country with an abundant supply of labor, are doubtless very real motives on the part of many. Many, moreover, desire to strengthen the friendly ties between themselves and their workers, while still others are swayed by the desire to check the mobility of labor, and see in family allowances a means of stabilizing their labor force. . . It may well be doubted whether [all these purposes] have been as influential as the fact that large groups of employers have seen in the family allowances system a means of avoiding the payment of

as large increases as they would otherwise have been forced to accord." Instances are given in illustration.

So also in Germany: "The employers have undoubtedly welcomed the system, because it enabled them to improve the condition of the married workmen at the expense in whole or in part of the single men."

Again, during a strike in France: "The married workmen receiving allowances went out equally with the unmarried workers, although by so doing they forfeited their allowances. M. Tessier, the Secretary of the National Federation of Catholic Workers, although a strong supporter of the family allowance system in general, charged the employers with what seems to be the patent fact, namely, that the increase in the allowance from 1 to 3 francs daily was given as a sop to conciliate the married workers with dependents, and to enable the economies to be made at the expense of the childless employees."

Having clearly shown that the attempt to make the childless men pay for the support of the married men's families has aroused the antagonism of organized labour throughout Europe, Professor Douglas, in Part III, recommends employers in his own country to establish equalization funds with the same object. "The way out lies in the fixation of a minimum wage sufficient to support single men with added allowances for dependent wives, children, and other adults."

"There is no reason why the single men should continue to enjoy a surplus over and above what is necessary to maintain them." In fixing the basic minimum wage, "the real choice lies between the cost for a single man living away from home and that for a man and wife. The latter is approximately 30 per cent. more than the former and represents roughly the added expense caused by matrimony. To pay all workers enough to maintain a man and wife would then mean paying the . . . bachelors approximately 30 per cent. more than they needed on a most liberal basis to support themselves." "The deflation of the wage of the single men might well furnish sufficient funds with which to pay the additional allowances for the children of the married and still allow a sufficient differential for skill." "The paying of the allowances to the mother of the family instead of to the worker himself would also lessen the jealousy of the single man. Both the single and the married men would receive the same minimum wage in the shop, irrespective of the number dependent upon them."

But employers in America should note that "the socialists and labor leaders in Australia and on the continent of Europe, together with the English feminists, unite in urging that the family allowances should be paid out of State funds and not from assessments levied upon employers." Also that in France the State has gone some way to meet this demand by an Act passed in 1922.

C. E. C.

14.—Other New Publications.*

The Accountant's and Secretary's Year-Book. Second issue, 1926. xxxiv + 391 pp. Edinburgh: E. and S. Livingstone, 1926. Price 10s. 6d. net.

[A compilation of material useful to accountants, secretaries and other professional men. The book includes a review of the year consisting of articles by experts on various commercial and financial matters and their latest developments, and contains also the Finance Act of 1925. Other sections deal with accountancy, company secretarial practice, education in the accounting and secretarial professions, and particulars of University training in commerce, available in the United Kingdom. A descriptive list of the latest business efficiency machines and office appliances is also included.]

Allmänna Pensionsförsäkrings Bolaget, 1898-1922. 219 pp. Stockholm: P. A. Norstedt & Söner, 1925.

[A report on the experience of the Swedish General Pension Assurance Company in the first 25 years of its existence (1898-1922). The book opens with a short review of the development of actuarial science, and the remaining sections describe the growth of the company's business, their mortality experience, disability and sickness insurance and its favourable results, the relative frequency of the more important causes of death and other insurance matter.]

Brookings (Robert S.). Industrial Ownership: its Economic and Social Significance. x + 105 pp. New York: Macmillan Co., 1925. Price 5s. net.

[The author having been actively engaged in business enterprises for more than twenty-five years is able to speak with some authority on industrial problems. In this book he deals with the far-reaching changes which have taken place in the organization of business during the last forty years, and points out how the present distribution of securities in the hands of the public has separated management from ownership. The effects of these changes are discussed at length, and the writer claims that "widespread diffusion of ownership and the increasing sense of responsibility of management to all the interested parties point to a satisfactory solution of the industrial problem." In dealing with the changed relations of Government to industry and of labour to industry thus brought about, the author urges that certain public measures are needed in order to secure better productive efficiency—a revision of the anti-trust laws in such a way as to permit of more extensive co-operation being a very necessary reform. The question of capital accumulation and the fear of over-production are also discussed. There are two appendices giving statistical data of the growth of consumers' ownership of certain public utilities and of the comparative earnings of investments in industry and banking.]

Canada: Dominion Bureau of Statistics. Agricultural Branch. Conference on Agricultural Statistics held in Ottawa, Jan. 29-31, 1924. 39 pp., fol. Typescript. 1925.

[A transcript of the shorthand notes of a conference which met to review the results obtained during the last six years in the compiling of annual

* See also "Additions to the Library," p. 383 *et seq.*

statistics of crops and live-stock by the Dominion Bureau of Statistics in co-operation with the Provincial Governments, and to consider possible improvements in the light of the experience gained. The subjects discussed covered practically the whole field of statistical investigation in relation to agriculture and live-stock.]

Crew (Albert). The Profession of an Accountant. viii + 117 pp.
London : Gee and Co., 1925. Price 5s.

[In this volume are collected a number of articles which have appeared in different journals devoted to the subjects of law and accountancy. There are chapters dealing with the functions, characteristics and etiquette of a profession and with the demand for the statutory registration of qualified persons. The three appendices include a survey of books on professionalism, notes on matters of interest to members of professional institutes or societies, and numerous excerpts in which capitalism, collectivism and professionalism are contrasted. There is an excellent index.]

The Economic Record. Vol. 1, No. 1, Nov., 1925. Melbourne : Melbourne University Press. Price 5s. net.

[The newly founded Economic Society of Australia and New Zealand are to be congratulated on the first issue of their Journal, which it is intended to publish twice yearly. The present number contains several articles of special interest in relation to Australian economic and financial conditions, and there are shorter notes on matters of topical interest. The reviews of books are an important feature of the publication, which includes also digests of legislation and accounts of the activities of the different branches of the Society. The *Record* will be welcomed by all interested in the development of the Commonwealth and of New Zealand.]

Fay (C. R.). Agricultural co-operation in the Canadian West. pp. 439-470. London : P. S. King, 1925. Price 1s.

[A reprint of the chapter in Prof. Fay's *Co-operation at Home and Abroad*, describing the co-operative movement and its growth in the Canadian Prairie Provinces, in Saskatchewan and British Columbia. The Pool era from 1923 onwards, its working on co-operative principles and the reaction of the wheat pools on other forms of co-operation are also examined.]

Foster (William T.) and Catchings (Waddill). Profits. xxii + 415 pp., 8vo. Boston and New York : Houghton Mifflin Co., 1925. Price \$4.

[This is a companion volume to the authors' earlier joint work on *Money* published in 1923. The main purpose of the book is to explain why industry is depressed by overproduction, when so many are suffering from insufficient consumption owing to their poverty and consequent inability to buy the commodities they require. While the authors are unable to explain completely the causes of these industrial troubles, they maintain them to be due in part to defects in the present monetary systems. The authors so far have dealt only with the larger aspects of monetary phenomena, but hope to be able later to propose plans for the solution of these problems. The book is one of the publications of the Pollak Foundation for Economic Research, who are prepared to pay 5,000 dollars for the best adverse criticism of it. There is an appendix of tables, numerous charts and diagrams, and an index.]

Friendly Societies. Reports of the Chief Registrar, for 1923. Part A. Appendix A. 44 pp., fol. H.M. Stationery Office, 1925. Price 4s. net.

[Contains statistical and other information based on the returns and valuations of various societies registered under the Friendly Societies Act. There has been a reduction in the membership of Trade Unions, Co-operative Societies and Working Men's Clubs, and an increase in membership in Friendly and Building Societies. Nearly all classes have increased their funds. Contributions and management expenses are shown for the first time since 1910. The former have increased 45 per cent. per member and the latter by 75 per cent. Summaries of the quinquennial valuations at the end of 1923 are included, and attention is drawn to the deficiencies occurring in certain classes of societies and their causes, with suggestions as to how they may be met.]

Johnes (Trevor). Foreign trade and exchange. 205 pp. London: P. S. King & Son, 1925. Price 8s. 6d. net.

[The author is Professor of Commerce at the Tokyo University of Commerce, and his book is an endeavour to summarize some of the changes in the practice, theory, and organization of foreign trade in the last ten years. It includes chapters on the law and practice relating to credits, the American federal reserve system and the financing of foreign trade, exchange and arbitrage, foreign trade with silver standard countries, and kindred subjects. The appendices contain facsimiles of various commercial documents.]

Ministry of Labour. Report on an Investigation into the Personal Circumstances and Industrial History of 10,903 Claimants to Unemployment Benefit, Nov. 24-29, 1924. 1925. Price 4s. net.

[This report is in continuation of that issued in March, 1924, which was noticed in the *Journal* for July, 1924, and formed the basis of Mr. Hilton's paper read before the Society in June, 1924. Apart from some minor changes it has been conducted on the same lines as the preceding enquiry, with which it is comparable. The results show a remarkable similarity, and lead up to the conclusion that a 1 per cent. sample is sufficiently representative to justify the conclusions drawn.]

Report of the Ministry of Labour for the years 1923 and 1924. Cmd. 2481. 280 pp. London: H.M. Stationery Office, 1925. Price 4s. 6d. net.

[This is the first complete report of the Ministry of Labour, covering mainly the years 1923 and 1924. It is intended in future to publish a report yearly. The book opens with an introduction describing the formation and powers of the Ministry, and succeeding chapters deal in detail with its functions in relation to Conciliation and Arbitration, Employment Exchanges, Unemployment Insurance, Administration of the Trade Boards Acts, Labour Statistics, International Labour Organization, Temporary functions arising out of the War, and the Joint Substitution Board. There are numerous appendices, mainly statistical and relevant to the subjects mentioned above, including statements showing the position of Great Britain in regard to conventions and recommendations adopted by the International Labour Conference.]

Morton (J. H.). National Finance. viii + 128 pp., 8vo. London : Gee and Co., 1925. Price 6s. net.

[The author's object is to help students and others to grasp the underlying principles of state finance, and to explain how the national revenue is raised, spent and controlled. The book is in five chapters, including one on national debts, with several appendices and an index. It is based on a series of lectures given in 1924-5, but the text has been considerably revised in consequence of the changes brought about by the Chancellor of the Exchequer's 1925 Budget proposals and the legislation arising therefrom.]

Phillips (H. W.). Modern Foreign Exchange and Foreign Banking. 312 pp., 8vo. London : Macdonald and Evans, 1926. Price 8s. 6d. net.

[Mr. Phillips' book differs from most of its kind, inasmuch as it deals almost entirely with the practical side of foreign exchange, the theory of the subject being treated only to the limited extent necessary to make the practical work intelligible. The main value of the book is due to the detailed descriptions of the working of foreign exchange business and the organization of the foreign exchange market. It is in twenty-one chapters, which includes one on forward exchange; and there is a useful appendix of statistical tables, which include bank rates of the world from 1910 to September 30, 1925, and highest and lowest rates of exchange for seven years.]

The Polish Handbook. 1925. Edited by Francis B. Czarnomski. xxxv + 704 pp. London : Eyre & Spottiswoode, 1925. Price 10s. 6d.

[A useful compendium of information concerning Poland, and the first of its kind, as is claimed by the editor. Every endeavour has been made to secure accuracy within the limits of the statistical data and other sources of information available, and many of the sections have been compiled by experts. The book includes descriptions of the constitution, government and history of Poland, its physical characteristics, its system of national education, production, trade and transport, labour and social welfare, finance, defence, and the cultural life of the people. There are numerous statistical tables, a map and a good index, in addition to a full synoptical table of contents.]

Rau (B. Ramachandra). Elementary Banking for Indian Beginners. ix + 199 pp. Calcutta : University Press, 1925.

[This book, as the title implies, is a primer for students desiring to know something of the theory of banking, and the author states that its purpose is purely educational. The functions of different types of banks are described, considerable space being given to the study of the commercial bank and its working.]

Ricci (Umberto). Dal Protezionismo al Sindacalismo. viii + 178 pp. Bari : Gius. Laterza & Figli, 1926. Price 12 lire.

[This volume is a collection of lectures on economic subjects delivered, within recent years, by Signor Ricci in the Universities of Pisa and Bologna. Protection, especially in relation to the steel industry, is treated at some length; guild socialism, syndicalism and bolshevism are also discussed and criticized.]

Spalding (W. F.). Foreign Exchange and Foreign Bills in theory and in practice. 6th edition. xv + 265 pp. London: Pitman, 1925. Price 7s. 6d.

[The first edition of Mr. Spalding's book was reviewed at length in the *Journal* for May, 1916, and the fourth and fifth editions, briefly, in the *Journals* for January, 1922, and July, 1923. The continued demand for this book has necessitated the present edition, which calls for little in the way of comment. In Chapter VII the present-day exchange rates have been fully explained, and some further pages on forward exchange have been added to Chapter XV. Some alterations in regard to gold points have also been necessary, owing to the resumption of the gold standard in this country.]

Taylor (E. Miles) and Taylor (F. H.). Income Tax and Super Tax. 3rd edition. viii + 268 pp., 8vo. London: Macdonald and Evans, 1926. Price 12s. 6s. net.

[Messrs. Taylor's book is a useful compendium of the rules governing the collection of income tax and super tax and of the relief and allowances granted under the different schedules of the income tax. A section of the book deals also with exemptions, and gives definitions of the various bodies to whom these are granted. There is also a chapter on the land tax and an appendix giving rates of income and super tax and copies of official circulars pertinent to the subject. The book is well indexed.]

Woodson (E. R.). Railway Accounting Procedure. 1926 edition. Edited by E. R. Woodson. 885 pp., 8vo. Washington: Railway Accounting Officers' Association, 1926. Price \$3.

[This elaborate book is primarily for the use of American railway accountants, though it is also of educational value to other classes of transport workers. It is in four main parts, dealing with Freights, Passengers, Disbursements and Overcharge claim rules, and there is also a section relating to Terminal charges and accounting. Nearly half the book consists of copies of the hundreds of vouchers, checks and forms of various kinds incidental to the working of American railways. There is an extensive bibliography showing the historical development of railway accounting and its tendencies towards uniformity. The book should be of interest to railway accountants in this country who may wish to compare their methods with those in use in America.]

CURRENT NOTES.

THE values of both imports and exports have shown a rather marked reduction on the corresponding figures of last year, both in January and February. In considering these figures it is necessary to bear in mind that prices have been on the down grade, so that the volume of business done is not precisely reflected in the comparison of figures of value a year ago and in recent months. This sagging of values, though it connotes a gain to the purchaser of goods, tends to restrict trade, if only because buyers who anticipate further reductions in quotations naturally hold back their orders as long as possible.

Our usual comparison of the latest period of twelve months for which particulars have been issued with the corresponding figures relating to a year earlier shows a reduction of £20 million in imports, mainly in the food class, and a reduction of £49 million in British exports, divided principally between raw materials and manufactures. The re-exports show increases which accentuate the reductions in imports of both food and raw materials, and in the manufactured class the value of imports retained has increased by £10 million. The export excess of bullion and specie has been decreased by over £5 million. The reduced coal-export trade is reflected in the decrease of tonnage cleared outwards with cargo, which has affected foreign vessels in a greater degree than British vessels.

	Twelve Months ended Feb. 28, 1926.	Twelve Months ended Feb. 28, 1925.	Increase (+) or Decrease (—) in later period.
Imports, c.i.f.—	£'000.	£'000.	£'000.
Food, drink and tobacco	568,098	584,460	— 16,362
Raw materials and articles mainly un- manufactured	408,984	417,597	— 8,613
Articles wholly or mainly manufac- tured	315,610	309,933	+ 5,677
Other articles	5,612	6,667	— 1,055
Total imports	1,298,304	1,318,657	— 20,353

	Twelve months ended Feb. 28, 1926.	Twelve months ended Feb. 28, 1925.	Increase (+) or Decrease (—) in later period.			
Exports, f.o.b.—	£'000.	£'000.	£'000.			
<i>United Kingdom Pro- duce and Manufactures—</i>						
Food, drink and tobacco	54,011	57,296	—	3,285		
Raw materials and articles mainly un- manufactured	80,785	103,477	—	22,692		
Articles wholly or mainly manufac- tured	605,178	627,674	—	22,496		
Other articles....	17,926	18,691	—	765		
<i>Imported Merchandise—</i>						
Food, drink and tobacco	31,356	29,052	+	2,304		
Raw materials and articles mainly un- manufactured	91,072	77,230	+	13,842		
Articles wholly or mainly manufac- tured	29,669	34,158	—	4,489		
Other articles ...	114	152	—	38		
Total exports	910,111	947,730	—	37,619		
Bullion and Specie—						
Imports ..	53,027	49,530	+	3,497		
Exports ..	56,519	58,244	—	1,725		
Movements of shipping in the Foreign Trade:	Number of Vessels	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.
<i>Entered with cargoes—</i>						
British	31,980	37,979	31,184	37,402	+ 796	+ 577
Foreign	22,659	17,605	22,467	18,691	+ 192	— 1,086
Total ..	54,639	55,584	53,651	56,093	+ 988	— 509
<i>Cleared with cargoes—</i>						
British	38,420	41,309	40,893	42,258	— 2,473	— 949
Foreign	21,974	20,816	25,099	23,165	— 3,125	— 2,349
Total	60,394	62,125	65,992	65,423	— 5,598	— 3,298

The level of wholesale prices, as measured by the Board of Trade index-number, continued to fall during the first two months of the year. For the month of January prices were on the average 1·2 per cent. lower than those for December; each of the food groups showed a decrease, the combined index for all classes of food showing a fall of 2·7 per cent., while price recoveries in iron and steel and in other metals and minerals limited the fall in prices of industrial materials to 0·5 per cent. Taking the average of prices in 1924 as 100, the index-numbers for January and February were 91·0 and 89·5

respectively, a reduction in the later month of 1.6 per cent. The February averages were lower than those for January for seven of the eight groups of commodities, the exception being that relating to food other than cereals, meat and fish, where increases in the prices of imported butter, apples, oranges, sugar and tea were responsible for a net increase of 1.9 per cent. in this group.

A similar downward movement in wholesale prices, as measured by the *Economist* index-number, at the end of January, and again a month later, brought this index at the end of February to 188.1, which is the lowest point touched for ten years. These changes reduced the increase over the pre-war level, *i.e.* prices at the end of July, 1914, to 61.4 per cent. ; the greatest increase of those making up this average figure was in food other than cereals and meat, prices of which were still 99 per cent. over the pre-war level, and the least was in the miscellaneous group, where the corresponding increase was only 38 per cent. It may be noted that the increase over the average for 1913 was 53.6 per cent., while *Bradstreet's* index-number of prices in the United States for the end of January showed an increase of 49.1 per cent. over 1913.

According to the *Statist* index-number, the reduction of wholesale prices between the end of December and the end of January was only 0.8 per cent., but the rate of decrease was somewhat faster again in February, *viz.* 1.1 per cent., so that this index-number at the end of the later month at 127.9 showed the lowest level recorded since October, 1923. Although there were increases in the smaller groups in each of the two months, the two large groups of foodstuffs and industrial materials respectively both recorded successive reductions in average prices.

The average rise of retail food prices in Great Britain and Northern Ireland since July, 1914, which was put by the Ministry of Labour at 71 per cent. on January 1, fell to 68 per cent. on February 1, and further to 65 per cent. on March 1, as compared with 76 per cent. on March 1, 1925. In January the reduction in the price of eggs was the most marked of the seasonal changes, and in February a further fall in the price of eggs was the only change of any appreciable size in a single commodity.

If rent, fuel, clothing, etc., be included with food, the average increase of retail prices on the pre-war standard of comfort, which stood at 75 per cent. on January 1, fell to 73 per cent. on February 1, and by a further slight reduction to 72 per cent. on March 1, as

compared with 79 per cent. a year before. From the fact that the food items accounted for 60 per cent. of the total family budget in July, 1914, it appears that on March 1 the increase in the items other than food was over 82 per cent.

The following table summarizes for the chief countries the latest information as to retail prices overseas as reproduced in the *Labour Gazette*. The third column gives the percentage increase in retail food prices on those ruling in July, 1914, or some similar pre-war period; the fourth column gives the estimated percentage increase for all the items covered by the budget in each case, such items, in addition to food, comprising generally rent, clothing, fuel and light, and other household requirements.

Country.	Date of latest return.	Food.	All items.
<i>Foreign Countries.</i>		Percentage Increase.	Percentage Increase.
Belgium	January, 1926 ...	—	427
Denmark	January, 1926	77	94
Egypt (Cairo) .	December, 1925....	62	—
France (Paris)	February, 1926 ..	395	321 (4th qr. 1925)
France (other towns)	November, 1925....	371	—
Germany	February, 1926	43 (Jan.)	39
Holland (Amsterdam)	December, 1925 ...	45	77
Italy (Milan)	January, 1926 .	581	565
Norway	January, 1926	116	134
Spain (Madrid)	December, 1925....	83	—
Sweden	February, 1926	60	74 (Jan.)
Switzerland	December, 1925....	67	67
United States	January, 1926 ..	61	74 (June, 1925)
<i>Overseas Dominions, etc.</i>			
Australia ...	December, 1925....	56	55 (3rd qr. 1925)
Canada	February, 1926	55	54
India (Bombay)*....	February, 1926 ...	50	54
Irish Free State	January, 1926	87	88
New Zealand	February, 1926	53	—
South Africa	January, 1926	16	31

* Native families.

In continuation of statistics relating to employment in Great Britain and Northern Ireland, quoted on p. 175 of the January *Journal*, returns from trade unions with a total membership of approximately one million members, showed 10·6 per cent. of their

members as unemployed at the end of January. A month later this proportion had fallen to 10·4 per cent., as compared with 9·4 per cent. at the end of February, 1925. With these figures may be compared the percentage unemployed among the workpeople, numbering 11,892,000, insured under the Unemployment Insurance Acts in Great Britain and Northern Ireland. Standing at 11·1 on January 25, it fell to 10·5 on February 23, as compared with 11·3 on February 23, 1925. Some indication of the magnitude of the aggregate figures corresponding to these percentages is given in the returns published by the Ministry of Labour showing the total number of persons registered at Employment Exchanges in Great Britain and Northern Ireland as applicants for employment at various dates. On February 1 this number was approximately 1,237,000, and on March 1 it had fallen to 1,169,000. A comparison with the position of a year before, as reflected in employers' returns received by the Ministry of Labour, is given in the following table. The returns relating to coal-mining and to the iron and steel trades cover the whole month in each case.

Week ending	Coal-mining. Increase or decrease on a year ago in days worked per mine per week.	Iron and steel trades. Percentage change on a year ago in aggregate number of men-shifts.	Other trades covered by the returns. Percentage change on a year ago.	
			Numbers employed.	Wages paid.
January 30	+ 0·08	- 1·8	- 2·4

Official statements as to employment in Germany, as summarized in the *Labour Gazette*, showed that unemployment continued to increase in December, but the rate of increase slackened in the first half of January, and by the middle of February there was a slight improvement, the number of unemployed on the "live register" of Employment Exchanges falling from 2,495,000 at the end of January to 2,488,000 on February 16. Returns from trade unions with a membership of over three and a-half millions indicated a percentage of unemployment rising from 10·7 at the end of November to 19·4 per cent. a month later, and still further to 22·6 on January 30, as compared with 8·1 per cent. a year before. In the case of Norway, the latest returns quoted by the *Labour Gazette* relate to the end of December, when the percentage of unemployed in the trade-union returns was 23·7, or nearly three times the rate of a year before. For Swedish trade unions, returns were given up to the end of January,

when the proportion of unemployed was 15.9 per cent. ; in this case the position was approximately equal to that at the end of January, 1925. Returns supplied to the Danish Statistical Department by trade unions and by the Central Employment Exchange indicated 31.1 per cent. of trade-union members as unemployed on January 29, or nearly double the proportion of a year before.

In Canada the index-number of employment, based upon returns received by the Dominion Bureau of Statistics from nearly 6,000 firms, employing approximately three-quarters of a million of workers, fell from 95.3 at the beginning of December to 89.6 a month later, as compared with 83.9 on January 1, 1925. The monthly report on employment issued by the Federal Department of Labour Statistics at Washington is now based upon returns received from over 9,400 establishments in 53 industries and covers nearly 3,000,000 workers. In December there was a decrease of 0.2 per cent. in the numbers employed, and January showed a further contraction of 0.4 per cent. Aggregate wages paid decreased slightly by 0.3 per cent. in December, but the reduction in January was more marked at 4.7 per cent. Thus the actual average weekly wage received increased by 0.4 per cent. in December, and fell by 4.3 per cent. in January.

Parts III and IV (issued December 31, 1925, price 32s. net) of Vol. XVII of *Biometrika* contain as a frontispiece a portrait of the anthropologist Rudolf Martin, twelve long papers and three shorter ones, and extend from pp. 201 to 479, together with two pages of index. Of the papers, there are two on the theoretical foundations of probability as related to statistics. The editor, Professor Karl Pearson, writes on the theorem commonly ascribed to James Bernoulli, that the accuracy increases with the square root of the number of samples, the proof of which is due to De Moivre, and points out that Bernoulli only found that by increasing the number of observations the results fell within certain limits. This he published in *Ars Conjectandi* in 1713, after twenty years' consideration of the problem, his method being to consider the ratio of the middle of the binomial to the tails, a method that, with the approximations that he gives, requires for any definite odds three times as many observations as De Moivre's formula needs. Mr. E. S. Pearson investigates Bayes' Theorem experimentally : he first takes samples of a fixed size ($n = 20$), with p successes and q failures of various propositions (e.g. number of men met smoking pipes), and then finds the distribution of r (where $r =$ number of successes in a

further $m = 15$). 12,448 double samples were thus obtained, and a U-shaped frequency-curve for $p + r$ obtained with slight deficiency at the extreme values. He then further considers experimentally the following question: in applying Bayes' Theorem, what is the probability that the range of r thus predicted in the second sample will not be exceeded more often than theory expects? He takes 300 cases (e.g. $p = 26$ men are seen in $n = 200$ with umbrellas: how many are seen in the next $m = 150$?) for n and m between 15 and 600, m often being greater than n . The frequency-distribution of $(p + r)/(n + m)$ is again U-shaped, though flat at the ends. For each double sample the statistical constants have been calculated, and the limits between which the central 90 per cent. and 99 per cent. calculated and compared with those actually found. The figures are 270 and 297 (s.d.'s 5.20 and 1.72) (calculated) and 271 and 294 (observed). There are then two papers on frequency-distributions, one by Mr. J. O. Irwin and one by Mr. L. H. C. Tippett. The former applies some conclusions of the individual difference problem to devising a test for the homogeneity of a number of observations and obtains a criterion of the rejection of outlying observations compared with which both the Peirce and the Chauvenet criteria are shown to reject too readily. Mr. Tippett in a theoretical and experimental inquiry has found the statistical constants for the distribution of the first or largest individual for samples up to 1,000 from a normal population, and finds that the distribution diverges more from normality as the sample increases in size: he also obtains criteria for the rejection of outlying members. Among other results he gives a method of finding the s.d. of the population, knowing the mean range and the size of the sample: this method gives better results for many and small samples (of order, say, 10) than for few and larger ones, but is inferior to the method of moments and of ranking.

Professor Karl Pearson contributes three papers on frequency-surfaces. He has taken a surface of the form

$$z = z \times (\text{exp. (quadratic in } x \text{ and } y)) \times (\text{quartic in } x \text{ and } y),$$

and found that the coefficients can be expressed in terms of the 15 constants: (1) volume, (2) of each variate the mean, s.d., β_1 and β_2 , (3) r , (4) third-moment production moment-coefficients, (5) fourth-order production moment-coefficients. Although there seems no reason to expect that the successive product moments will be convergent, and thus the neglect of fifth-order product moments may not be justified theoretically, yet the surface may be anticipated to give a better fit than those of fewer constants. It fits remarkably

ERRATUM.

In the MARCH issue, p. 366, line 33.

“ Professor Karl Pearson contributes three papers ”

should read—

“ Professor Karl Pearson contributes one of three papers ”

well the cancrine forms of the contours for the distribution of whist hands given by the hyper-geometric series. But the Southampton-Laudale barometric heights do not give such a good result: the observations, for one thing, seem bimodal. Mr. Rhodes takes the Edgeworth surface:*

$$z = (\text{exp. (quadratic in } x \text{ and } y)) + \text{functions of } \frac{d^{m+n}}{dx^m dy^n} (\text{exp.}),$$

for m and n integral and 0 to 3, $m + n = 3$.

This involves 9 constants, no fourth moments entering in, and the surface is more easily calculated than the Pearson 15-constant surface. The surface does not apparently fit so well. Dr. Camp considers mutually consistent multiple-regression surfaces. He points out the difficulty in assuming simultaneously that:

regression of z on x , y is $z = \text{polynomial in } x \text{ and } y$; and
total regression of z on x is $z = \text{polynomial in } x$,

as there are interrelations between regression surfaces and curves either rigidly determined or practically assigned. Taking the total regression of y on x as

$$y = \text{polynomial in } x / \text{polynomial in } x$$

(e.g. a simple Narumi surface is $y = a/(cx + d)$),

he points out that just as restricting regression curves in two-way correlation tables involves restriction on marginal total-frequency distributions, so we get interrelations between three-way tables, and we can either assume simple expressions for the total regression curves or for the regression surfaces. The partial regression is simpler, because, if y is fixed, one is dealing with more homogeneous population than when y is allowed to vary. All methods lead to complicated results.

We turn next to three papers, etc., dealing with correlation. Professor Yasukawa considers the relations between functions of variates, e.g. r_{uw} , when $u = f(x)$, $w = F(y)$, x and y have known frequency-constants, and their coefficients of variation are of order 2 to 8. He finds that if x is normal, a normal curve cannot be exactly fitted to u (the error may be 7 per cent.), but that r_{ux} is practically 1 (e.g. .999). Then r_{uw} is also practically equal to r_{xy} . This gives, if $x = \text{stature of fathers}$ and $y = \text{stature of sons}$, where $r_{xy} = .515 + .015$, that if $u = x^3$, $y = w^3$, then $r_{uw} = .514$, the exact correlation-table method result.

In a paper in the same publication, Miss Ethel M. Newbold considers the errors in the partial correlation coefficients, both

* See *Journ. Stat. Soc.*, Jan., 1926, p. 142.

experimentally and theoretically, the data considered being the Cripps-Greenwood-Newbold vital capacity interrelations (where 950 observations give practically normal distribution and linear regression, and the different methods of determining correlation give no practical difference), the Brown-Greenwood-Wood index correlations (where the distributions are limited and very skew and the practical differences found again small) and the de Souza female pelvis diametric measurements (where the product moment coefficients are smaller, but still the absolute difference in the correlations is smaller than that due to random sampling). She particularly approves of Pearson's Q_5 . The editor contributes three notes: one on Miss Newbold's paper, stating that the product-moment correlation has no prescriptive pre-eminence, and that several correlation methods should be used on the same data if possible. The next deals with the disadvantage that the correlation ratio $\eta = S \frac{\sum (\bar{y}_x - \bar{y})^2}{N\sigma_y^2}$ does not give an average of zero. He

suggests therefore an $r = \frac{1}{z_1 + z_2} \frac{\sum (\bar{y}_x - \bar{y})}{N\sigma_y}$ for ranges right and left of median, taking positive differences, and summed for all arrays and always with the same sign, where $\frac{Nz_1}{\sigma_x}, \frac{Nz_2}{\sigma_x} =$ ordinates

of normal curves at start and end of median array. This is appropriate if there is normal correlation: it avoids the class-index correction, and is particularly useful if one variate is qualitative and the other quantitative. The values obtained are in good agreement with those calculated by other methods. The last point he deals with is Lenz's *Deutsche Korrelations-Index*, which he points out is simply the usual product-moment ratio in the case of normal distribution. To statistical theory there is one other contribution: Dr. Splawa-Neyman writes on the statistical constants for random small samples from finite population of known frequency-distribution. He gives generalizations of formulæ previously given by other writers. If the frequency-distribution of the original population be symmetrical, the correlation between the mean and the variance is always zero, but in general there is not independence unless the original population is indefinitely large and normal. Dr. Alice Lee gives a table of the first 20 tetrachoric functions to 7 decimal places for $h = 0.0, 0.1, 0.2, \dots, 4.0$, and Mr. Wishart one for $\int_0^\theta \cos^n \theta d\theta$ for n large (of order, say, 10 to 400).

The remaining two papers are of special interest to vital statisticians. Dr. M. Greenwood and Miss Newbold consider Lenz's deduction from the theory that, as the Mendelian inheritance of sex is now established, we may expect that the recessive pathological hereditary characters should be found only in males. Lenz inferred that if the higher infantile mortality is selective, and if a non-selective factor (*e.g.* a general environmental character such as a hot summer or an epidemic) appears, there will be a reduction in the relative excess of the male deaths. Considering x as the male infantile mortality and y as the female, Lenz claims that $r_{x/y, x+y}$ should be large and negative, and instances Hungary ($r = -.81$). The writers here find that v_y is greater than v_x and point out that simple sampling would therefore lead, as male mortality is heavier, to a negative correlation: the higher the male birth-rate the more pronounced is this. They conclude that it is not easy from the results to find support for any theory of connection between sex differences in variation and the unavoidable mortality attached more to one sex than to the other. Finally, Professor Westergaard contributes a paper on some developments in vital statistics and the use of available material to deal with such questions as the force of mortality due to different causes, marriage-rate of bachelors at different ages (he gives for Denmark the results for 1787 and 1911 compared: at age 25, 4 per cent. and 12 per cent.; 35, 14 per cent. and 10 per cent.; 45, 13 per cent. and 3 per cent.), withdrawals from religious confessions, migrations, mortality of the feeble-minded, and the incidence of blindness.

The fundamental anthropology of Scotland is discussed by Dr. John Brownlee in *The Origin and Distribution of the Racial Types in Scotland*, recently published by the Henderson Trust. The author compares the local distribution of different types of prehistoric remains—each type characteristic of its own civilization—with the distributions of hair- and eye-colour, stature and head-form of the present-day inhabitants. The sources used for the latter are Dr. Beddoe's pigmentation survey of the British Isles, a similar survey among Scottish school children, measurements made at the instance of the Henderson Trust on the asylum populations of Scotland and on the local populations in Aberdeenshire and elsewhere, and measurements of recruits from different parts of Scotland during the war.

Dr. Brownlee finds a close correspondence between the distribution of stone forts or "brochs" and that of a high cephalic index. Hence he postulates a seafaring feudal empire in the North of

Scotland, founded by invading broadheads, probably from the Eastern Mediterranean, and suggests that some of the Scottish place-names whose origin is obscure may have originated from the same place.

Likeness in place-names, prehistoric food vessels, and modern race pigmentation is pointed out as evidence of a close connection of Ulster and the N.W. of Ireland with Scotland in prehistoric times. A correlation is shown to exist between jet-black hair and narrow heads, and Dr. Brownlee finds a local excess of light eyes associated with the presence of dolmens. He thinks it clear that the type of immigrant possessed of dark hair and light eyes landed in the West of these Islands in very considerable numbers, but can find no evidence of their presence in the East.

Fellows of the Society will be interested to learn that their President, Mr. G. Udny Yule, C.B.E., M.A., F.R.S., has been elected to the Fellowship of University College by the Senate, on the advice of the College Committee. Mr. Yule was Newmarch Lecturer on Statistics at University College from 1902 to 1909, and is also a former Life Governor of the College

Another item of interest to the Society is the recent award to Dr. Major Greenwood, F.R.C.P.—one of the Society's Honorary Secretaries and Editors of the *Journal*—of the Weldon Memorial Prize for the encouragement of Biometric Science.

The Sixth General Index to the *Journal of the Royal Statistical Society*, covering the period 1909 to 1924, is now published. The Index may be obtained by Fellows for the nominal sum of 1s., and by the public for 2s. 6d.

OBITUARY.

FRANCIS YSIDRO EDGEWORTH, F.B.A., M.A., D.C.L.,

Emeritus Professor of Political Economy, University of Oxford.

PROFESSOR EDGEWORTH first became known to the writer of these lines at the meeting of the British Association at Bath in 1888, when we acted together as Secretaries of Section F. Not long after, his election to the Drummond Chair brought him to Oxford, and our intimacy ripened. Through the thirty following years we made a practice of a walk and talk once a week during Term ; in vacations he was generally away in lodgings at Hampstead or elsewhere. Being no mathematician, I could not follow with understanding the greater part of his large contribution to the nice refinement of abstract economic theory jealously purged, as he tried to render it, of the corruption of concrete content. Nor could I dare appraise the meticulous scrutiny of the bases of statistical technique, his regard for which was religious in its intensity and depth. Surrendering, therefore, properly to others the obligation of gauging what I feel must have been rare quality, or supremacy, in these high regions, I gladly seize the opportunity of the suggestion of the Editors of this *Journal* to say something about the attractive person whose close, long friendship I was privileged to enjoy, obtaining, as I hope, thereby insight into the curious working of a distinguished mind, and entry, at any rate, to some recesses of his amiable nature and fine character.

As Oxford Professor he followed Thorold Rogers. Alike as they might perhaps be deemed in uncommon general ability and unique brain power, and in outstanding tireless devotion to the particular branch of reasoning and research to which respectively they attached their strength, we should not easily find a more marked contrast than was evident between the two in the drift of their study and in their conception of the mode and temper fit for its pursuit. The one was positive and sure, quick to form and resolute to maintain dogmatic, independent, sharp opinion. The other, hesitating and tentative, was always seeking shelter behind deference to multiplied authority, and yet was not displeased to find, and was punctilious

in exhibiting, minute discrepancies in the numerous texts consulted, ending, as a result, to all appearance, in more, rather than less, unstable ambiguity than that with which he started. Either had the defects of his qualities. While the origin and sequence of changing belief were, I think, the only kind of economic history which interested Edgeworth, his robust and doughty predecessor, concentrating avowedly on past fact, of which nevertheless he formed rigid, and indeed not seldom biassed, explanations, might, it is probable, had he lived, have vented the vials of the scorn that he commanded in unstinted measure on the gently probing rapier thrust and counter-thrust of his polite and flexible successor, tilting, as he would probably have held, at unsubstantial fancies and expired ghosts.

I must own at the outset that some ardent zealots in our number, who longed to raise Economics from the ignoble level, at Oxford, of a tolerating, grudging, subordination to other studies to the prominent status of recognized autonomy, won at Cambridge through Marshall's influence and effort, sighed sometimes at the absence of pugnacity, and the dread of assertiveness, which Edgeworth courted. We should have liked a spice, at least, of the fight that was in Rogers. I myself should not be candid if I did not mention here that I tried hard in our weekly conversations to urge him generally forward and, particularly, to persuade him that a golden opportunity for marked advance was offered and, alas, was being missed, after the war. For it was then proposed to merge Economics, once again, in the so-called "Modern Greats" projected by the teachers of philosophy, in lieu of a programme of more independent, more complete and satisfying recognition brought forward, in another quarter, by the Committee for Economics and Political Science. There is a grim melancholy irony for me, as the Secretary for many years of that Committee, in hearing recently from a private but authoritative Oxford correspondent that in fact, so far as the conditions of the amalgam which was chosen allow, Economics is turning out "first favourite" in the hierarchy officially arranged as *Philosophy, Politics and Economics*, with Philosophy second and Politics a third. But, partly from a loyalty, with which I sympathized, towards the ancient school of *Literæ Humaniores* that had been our common training-ground as undergraduates, and unwillingness to depreciate or impair so admirable an education as that, in our joint belief, had proved, and partly also from instinctive cultivated liability to bend in turn to views, pressed successively with force, however divergent they might be, my counsel, right or wrong, of stout aggressiveness did not avail.

It was typical of Edgeworth's general attitude and conduct in academic politics that he took no part in the subsequent debates in Convocation on the matter, and, asked his opinion by the chairman of a conference summoned earlier of representatives of Council and advocates of the two schemes, gave the halting, albeit honest, answer that there seemed much to be said on either side. Although *ex officio* member of the Board of Faculty of Modern History, he was a rare attendant, and therefore exerted little influence at its meetings.

I have dwelt on this passing incident and external posture because there was, as I suppose, a deeper cause for his manifest reluctance to prefer a bold, large claim for Economics in the curricula of his own University, though he did not withhold his countenance from the Cambridge Tripos. As a lecturer, it must be granted, he travelled soon beyond the ken or grasp of ordinary students, as in the discussion in articles or reviews of burning questions of the day he was wont to introduce recondite argument and nice consideration that to average readers could only seem far-fetched. He ran, indeed, thereby the risk of ridicule or blame for indifferent toying with explosives or callous handling of vital issues. He might descend eventually on one side or the other of the fence, but, in spite of some affirmative or negative opinions occasionally allowed in intimate talk, on mischievous or mistaken tendency or act, and damning exposure of gross fallacy, in most public, and even private, utterances he kept himself so long poised evenly midway that the final movement, when, and if, it happened, was apt to be unnoticed. This was the case, for instance, with his treatment of the proposed levy upon capital ; and yet in his attitude towards the abortive duties on land-values he vaunted unabashed a liking for those " minus quantities " which disquieted or deterred plain men. In earlier controversies, as on bimetallism, he was non-committal, though alert to see and eager to expose illogical argument. The underlying prompting motive throughout, I feel tolerably sure, was this: he was obsessed by the intrinsic hardness and intertwined complexity of economic reasoning as he conceived and practised it. Again and again, in the course of our weekly walks, do I remember him concluding some discussion with the characteristic commentary that our subject was so difficult and complicated. I was wont to plead *en revanche*, but, I fear, without his lasting approval, that the older masters, like Adam Smith, and later exponents, such as Mill and Bagehot, had known how to inform and direct plain citizens with clear, intelligible interesting logic, without mathematics ; and on many, if not most,

of those vexed, puzzling practical proposals on which he took so much pains to preserve an open mind, I distressed and shocked him, I fear, as I hopefully sought and cheerily announced firm and plain conclusion on the one side or the other. If my egotism may be excused, I will add that I was as inveterate a believer in the possibility, wholesomeness and need of popular instruction as he, I am certain, doubted and denied its potency, desirability or wisdom.

On this account his more useful work as Professor, apart, of course, from world-wide distinction won by profound, assiduous research, and from the successful editorship of the *Economic Journal*, where comprehensive catholicity was, as Mr. Keynes has shown, no demerit, but the reverse, lay, I think, in "informal instruction." Here, I gathered, he was strikingly felicitous in overcoming the initial inertia of arousing and maintaining a brisk, enlightening discussion, and deftly he compelled his class to debate energetically among themselves rather than listen merely to a conversational discourse from him. He was quick to discern real aptitude and good ability and, when drawn upon for contribution, could with facile skill detect, if he could not expose transparently, fallacious reasoning. He was fitted, in short, for the better or the best, and not for the worse or mediocre pupil. He was, however, no unskilled examiner. He was fair but discriminating, if inclining to agree with rather than dissent from colleagues, and to seek for their verdict first before he pronounced his own. Similarly, as I judged, as Secretary for twenty-five years, at the meetings of the Oxford University Political Economy Club, which had been the child of Thorold Rogers, though it ran some risk in its early days, I understand, of being smothered by its begetter, Edgeworth, a regular diner, was more happy at critical participation than at expository introduction. His rich stores of fine economic knowledge and apt classical or literary quotation came appropriately into play, and with the elaborate manners and urbane comity conspicuous in all social relations, he would seek to embrace in a broad conspectus flattering remarks on the various opinions that had been advanced by previous talkers. In an opening statement, by contrast, he might leave his hearers, if he did not get himself, befogged in allusive reference and massed reservation.

I can perhaps present the most trustworthy vivid picture of the man by further account of our weekly walks and talks. His physical vigour was such that it was not easy at times to keep pace with him, and I suspect that often I returned more tired than he, despite the disparity in our ages. This remarkable virility of body, like his unique

subtlety of mind, continued happily to the last. He liked to get soon into air more stimulating than that which circulated at the low level of the Oxford marsh. He would generally start with swift strides, but before we had gone very far I would notice him feeling in his pocket for a slip of paper, furtively produced, to refresh his memory upon items noted through the week for consultation. Sometimes it was a tiny detail in the working of the *Economic Journal* and sometimes a small problem of daily life with which he had been grappling more or less unsuccessfully. At other times something was raised connected with a picture or a play which he had seen, or a film which he had witnessed (at one period he was much interested in visiting cinemas), or a book in general literature which he had been reading or re-reading. But most of the interrogation aimed at me was on Economics, and generally it was about theory rather than practice. The point was usually minute and subtle, and it was seldom that its raising was not joined to fortifying reference to a number of authorities, often perhaps conflicting or at least slightly differing. A completely satisfactory solution was rarely reached. But another authority, if I may be so bold, of less or more weight, was balanced in the scales, and the impression of the intrinsic difficulty and tangled intricacy of the question confirmed or enhanced. Such judgment as he had himself formed previously was dragged out rather than put forward, and, when expressed, was immediately hedged about with *caveat* and *proviso* . Yet the discussion for the other interlocutor "shed light" if it did not "bear fruit," and, on the way, exerted a kaleidoscopic charm produced by the appreciative, discerning familiarity with a very wide range of the best literature, modern and ancient, that my companion had, and employed with unforced ease. It was impossible, so kindly affectionate he was, to quarrel with him, and differences of view were induced to shade so delicately and imperceptibly into one another that they did not warrant any *casus belli*.

The contents of the rooms he occupied at All Souls seemed to me indicative. The few books were full of paper slips, inserted, I suppose, to facilitate quick and constant reference. Of adornment and of comfort there was little sign. And yet Edgeworth took a genuine pleasure in travel in Italy, for instance, although I recollect that on one such fascinating journey in his company he obviously considered it an imperative duty, after frivolously spending time like any ordinary tourist, such as myself, upon fashionable sight-seeing, to resort to the corrective of serious attendance at a formal lecture on a learned

subject. He was, too, hospitable to a degree, and his eagerness to entertain his friends was only curbed by limiting space at the All Souls high table. But it belonged to his Irish nature that, after inviting a large gathering to tea before a lecture he had arranged for with a distinguished visitor, he should go round the assembled company telling them in succession that they were not obliged to do what they might reasonably anticipate and stop to form the nucleus of an audience. I hope that I may be pardoned if I end this account of a loved, respected friend with another anecdote illustrative of his deferential courtesy and fluid opinions. He once came to dine with me *tête-à-tête* in Oriel in the depth of the Long Vacation, and, as he passed into the second quadrangle, remarked on the beauty of the creeper then growing on the wall of the Common Room. I concurred, adding, however, that a member of our body had lately urged its removal. Instantaneously came the complimentary observation "a very just opinion," and I do not think that he cared for, if he noticed, any inconsistency with what he had been saying. I must append to this sincere, if unworthy, narrative, that I sorrowfully feel that I shall not see his like again. L. L. P.

PROFESSOR EDGEWORTH, whose death deprives our Society of one of its most admired and trusted leaders, was elected a Fellow in April, 1883. He quickly took a leading part in the work of the Society, and by his frequent contributions to the *Journal*, whether in the form of papers read before the Society or under the heading of "Miscellanea," from the year of his election till that of his death, led the way in the applications of mathematics to the statistical treatment of social and other problems. During the illness which proved fatal he was engaged in the correction of the proof sheets of the last of this long series of learned papers, that which appeared in our issue dated January of the current year.

It is not possible to give in a short space any adequate summary of Edgeworth's contributions to the theory of Statistics. They touch on nearly every point at which mathematics has been applied to the analysis of numbers, but relate especially to the general theory of Probability (*e.g.* in the article so named in the *Encyclopædia Britannica*, 1911), to the theory of Index Numbers (*e.g.* Reports of the British Association, 1887-9), and to the Representation of

frequency-groups by mathematical formulæ (in the *Journal of the Royal Statistical Society*). His papers are scattered in a number of journals, and it is not easy to follow either his detailed treatment or his general line of thought, unless one is familiar with many of his studies. His general standpoint is unique, at least in England and America, and differs also from those of continental statisticians, and his work is not widely known or understood. At a time when empirical mathematical statistics are so common, it is of the first scientific importance that this fundamental analysis of the basis of the statistical applications of the theory of Probability, and this patient tracing of its implications to their farthest complexity should not be lost. It is hoped that some means will be found of collating Edgeworth's statistical papers and making them available to serious students of the theory of the subject. In the anticipation that this may be done, we make no attempt to give, on the present occasion, any considered appreciation of the work represented in those papers.

Professor Edgeworth was first elected to the Council in 1886, and served, with short intermissions, until 1912, when he became President for the usual term of two years. In 1907 he was awarded a Guy Medal in gold in recognition of the great value and distinction of his statistical work.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS.

UNITED KINGDOM—

Accountants' Magazine. March, 1926—Elements of life contingencies: *Sprague (A. E.)*.

Bankers' Magazine—

February, 1926—Banking profits and balance sheets. Credit and trade in 1925. A banking homily: "*Scrutator*."

Bankers' clearings in 1925. Bank-rate chart and statistics: (*A. H. G.*).

March, 1926—The financial and commercial outlook. The nationalisation of banking: *MacArthur (D. G.)*.

Economica. March, 1926—The dynamics of capitalism: *Robbins (Lionel)*. Freedom of transit in the air: *Buxton (S. W.)*.

Juvenile employment in West Ham: *Roker (Peter)* and *Scott (H. C.)*. The factory system of the 19th century: *Hutt (W. H.)*.

Economic Journal. March, 1926—Family allowances: *MacGregor (Prof. D. H.)*. The land and the nation: *Whetham (C. Dampier)*.

The profit cycle in agriculture: *Belshaw (H.)*. The gold standard and the balance of payments. *Hawtrey (R. G.)*.

The distribution of national income: *Procopovitch (Prof. S. N.)*. The Irish Census of Population: *Oldham (Prof. C. H.)*. The Road Fund and taxation of motor vehicles: *Allen (J. E.)*.

Obituary, F. Y. Edgeworth: *Keynes (J. M.)*.

Eugenics Review. January, 1926—Expenditure on education and its effects on fertility: *Darwin (Major L.)*. Genius as a biological problem: *Mjœen (Dr. Jon. A.)*. Decline in the birth-rate and "fecundability" of woman: *Gini (C.)*. The physiological factors governing the proportions of the sexes in man: *Parkes (A. S.)*.

Financial Review of Reviews. January–March, 1926—Trade Chances in Latin America: *Good (E. T.)*. Some defects in company balance sheets: *Gluckstein (S. M.)*.

Journal of the Institute of Actuaries Students' Society, Vol. II, No. 5. 1926—Valuations under the Industrial Assurance Act, 1923: *Laing (J. Murray)*. Methods of finding the yield on stock-exchange securities: *Bray (J. F. L.)*.

Journal of the Ministry of Agriculture. February, 1926—Field experiments: how they are made and what they are: *Russell (Sir John)*. Comparison of Scandinavian and British pig-breeding methods. II. Swedish methods: *Davidson (H. R.)*.

UNITED KINGDOM—*Contd.*

Public Health. February, 1926—Industrial hygiene.

Journal of the Surveyors' Institution. February, 1926—Rating and Valuation Act, 1925 : *Konstam (E. M.)*.

INDIA—

Journal of the East India Association. January, 1926—The warp and the woof of the fabric of Indian life : *Sorabji (R. K.)*.

Indian Journal of Economics—

July, 1925—Sixty years of Panjab food prices, 1861-1920 : *Myles (W. H.)*. Principles of labour legislation in India : *Lokanatham (P. S.)*.

October, 1925—Village surveys : *Moreland (W. H.)*. The relation of house-rent to income : *Gupta (Raj Bahadur)*. The relation of house accommodation to child mortality (reply to comment) : *Gupta (Raj Bahadur)*.

UNITED STATES—

Annals of the American Academy of Political and Social Science. January, 1926—A series of articles by various authors on industrial safety.

Harvard Business Review. January, 1926—The rôle of paper profits in industry : *Putnam (George E.)*. The extent and application of psychology and psychological method in English industrial life : *Miles (George H.)*. The motor-'bus situation in 1925 : *Latimer (Murray W.)*. The French cotton industry after the war : *Posthumus (N. W.)*. Summaries of business research.

Journal of Political Economy—

December, 1925—The utility concept and its critics. II : *Viner (Jacob)*.

February, 1926—The task of the English Coal Commission : *Hewes (Amy)*. "The worker in modern economic society" : *Slichter (Sumner H.)*.

Quarterly Journal of Economics. February, 1926—Chapters on machinery and labour. IV. Trade-union policy : *Barnett (George E.)*. The development and purposes of farm-cost investigation in the United States : *Bennett (M. K.)*. Progress and poverty in current literature on valuation : *Bonbright (James C.)*.

Review of Economic Statistics. January, 1926—Review of the year 1925. A weekly index of money rates, 1922-25 : *Hubbard (Joseph B.)*. Money rates and security prices : *Persons (Warren M.)* and *Frickey (Edwin)*.

ARGENTINA—

Revista de Ciencias Económicas—

September, 1925—Apuntes sobre el cálculo de las probabilidades : (continuación) : *Galí (José González)*.

October, 1925—Conferencias del profesor Guillermo A. Sherwell en la Facultad de ciencias económicas en septiembre de 1925. Transformaciones del régimen agrícola de Rusia.

EGYPT—

L'Egypte Contemporaine—

December, 1925—L'Égypte et une banque centrale d'escompte : *Bourkser (D.)*.

January, 1926—Nombres indices des prix du gros dans les villes du Caire et d'Alexandrie pour le mois de décembre 1922-1925.

FRANCE—

Bulletin de Statistique et de Législation Comparée. October, 1925—La production des alcools en 1924. Les octrois en 1924. Allemagne : La réforme fiscale du 10 août 1925.

Journal de la Société de Statistique de Paris—

January, 1926—La statistique des familles norvégiennes au recensement de 1920 (*fin*) : *Bourdon (Jean)*. Nos pertes de guerre ; leurs réparations et nos dettes de guerre (*fin*) : *Cadoux (Gaston)*.

February, 1926—Le développement de l'organisation antituberculeuse en France : *Moine (Marcel)*.

March, 1926—Méthodes à suivre pour la préparation des statistiques des stocks (*à suivre*) : *Methorst (H. W.)*. Prévisions relatives aux paiements en nature des réparations et des dettes interalliées (*à suivre*) : (*Yves-Guyot*).

Journal des Économistes—

February, 1926—A propos du rapport de la Banque de France : (*Yves-Guyot*). Les dettes interalliées : (*X.*).

March, 1926—Réflexions sur la situation financière : (*Yves Guyot*). Du caractère des opérations de banque dans les principaux pays européens : *Gauboue (Pierre)*. La Loi des sept heures pour les mineurs britanniques : *Lupton (Arnold)*. La reconstitution financière de l'Italie : *Stefani (Alberto de)*.

La Réforme Sociale—

December, 1925—Les nouvelles tendances fiscales du projet de budget de 1926 : *Lecerclé (M.)*.

January, 1926—La main-d'œuvre allemande et la reconstruction des régions dévastées : *Allusson (R.)*. Le mouvement économique et social : Pays de langue anglaise : *Angot des Rotours (Baron J.)*.

February, 1926—Chômage et salaire réel en Angleterre dans la période 1919-1925 : *Rueff (J.)*. Le mouvement économique et social : France et Belgique : (*Lepelletier F.*).

FRANCE—Contd.

Revue d'Economie Politique. November–December, 1925—L'indice monétaire et la théorie de la monnaie (*suite*) : *Divisia (François)*.
Prix, circulation et change en France de 1920 à 1924 : *Aftalion (Albert)*.

HUNGARY—

Revue de la Société Hongroise de Statistique. July–September, 1925—La statistique et l'exploitation des chemins de fer : *Neumann (Charles)*.

ITALY—

Giornale degli Economisti e Rivista di Statistica—

December, 1925—Impressioni di equilibrio instabile nel movimento delle società per azioni italiane : *Porri (Vincenzo)*.

Il salario della donna rispetto a quello dell'uomo : *Zingali (Gaetano)*. Il metodo statistico : *Vinci (Felice)*.

January, 1926—La crisi della "stabilizzazione monetaria" : *Bresciani-Turroni (C.)*.

February, 1926—L'offerta del risparmio : *Ricci (Umberto)*.
G. B. Salvioni : *Zingali (Gaetano)*.

Giornale di Matematica Finanziaria. December, 1925—Il calcolo dei momenti delle funzioni del rischio nell'ipotesi del Makeham : *Vecchio (E. Del)*. Abbaco per il calcolo delle annualità : *Luckey (P.)*.

La Riforma Sociale. January–February, 1926—Sulla misura della variazioni della prosperità economica : *Jannaccone (Pasquale)*.
Intorno alle condizioni alimentari del popolo italiano—considerazioni statistico-fisiologiche : *Camis (M.)*. Il momento monetario attuale : *Garino-Camina (Attilio)*.

SWEDEN—

Ekonomisk Tidskrift—

Häft 10–11, 1925—Valutaspörsmålet i de skandinaviska länderna : *Wicksell (Knut)*. Den korta kreditens nationalekonomiska betydelse : *Lindahl (Erik)*.

Häft 12, 1925—Teoretiska anmärkningar rörande 8-timmarsdagen : *Åkerman (Gustaf)*. Guldmyntfotens framtid : *Davidson (David)*.

Häft 1, 1926—Varuvärde och penningvärde : *Davidson (David)*.

SWITZERLAND—

Journal de Statistique et Revue Economique Suisse. Fasc. IV, 1925—Die eidgenössischen Volkszählungen seit 1850 : *Schwarz (Arnold)*. Der moralische Stand der schweizerischen Bevölkerung : *Mangold (Fr.)*. Der sozialwirtschaftliche Stand der schweizerischen Bevölkerung : *Schorer (H.)*. Die Sterblichkeit der schweizerischen Bevölkerung : *Wyler (Julius)*.

INTERNATIONAL—

International Labour Review—

January, 1926—Social aspects of land reform in Esthonia : *Martna (M)*. Vocational guidance in the U.S.A. A proposal for national insurance in Australia. The results of compulsory labour service in Bulgaria from 1921 to 1925.

February, 1926—Industrial diseases : Analysis of Factory Inspection Reports, 1920-22. I.

March, 1926—The influence of machinery on agricultural conditions in North America : *Riddell (W. A.)*, *Ph. D.* Industrial diseases : Analysis of Factory Inspection Reports, 1920-22. II.

Metron. Vol. V, No. 2, I-IX, 1925—On sampling : *Rhodes (E. C.)*. Height and weight of school children in an English rural area : *Dunstan (W. R.)*. Dubbi intorno ad alcune leggi demografiche : *Boldrini (M.)*. Life-tables of the city of Leningrad : *Novoselski (S.)* and *Paevski (V.)*. The growth of population in England and Wales : *Greenwood (M.)*. La popolazione della Sicilia preellenica : *Zingali (G.)*.

LIST OF ADDITIONS TO THE LIBRARY.

Since the January, 1926, issue, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom and its several Divisions.

United Kingdom—

A collection of Acts relating to Death Duties, 1796–1914. xxviii + 411 pp.; Supplement for the year 1915. 16 pp. London, 1915–16. (Mr. F. Finch.)

Report to the Secretary of State for Dominion Affairs of the Inter-Departmental Committee appointed to consider the effect on migration of schemes of social insurance. Cmd. 2608. 32 pp. London, 1926. Price 6d. net. (H.M. Stationery Office.)

Coal Commission. Report on the Coal Industry (1925), with minutes of evidence and appendices. Vol. I. Report. xiv + 294 pp. London, 1926. Price 1s. net. Cmd. 2600. (Purchased.)

Imperial Mineral Resources Bureau. Mineral industry of the British Empire and foreign countries. Statistical summary, 1922–24. 337 pp. London, 1925. Price 8s. net. (The Department.)

Overseas Trade, Department of. Reports on conditions in Algeria, 1924–25. Argentine Republic, September, 1925. Brazil, September, 1925. Cuba, November, 1925. Cyrenaica, 1924–25. Dominican Republic, September, 1925. Ecuador, September, 1925. Hayti Republic, 1924–25. Morocco, 1924–25. Paraguay, September, 1925. Siam, March, 1925. Tunisia, 1924–25. U.S.A., September–October, 1925. Venezuela, September, 1925. (The Department.)

Post Office Savings Bank. Accounts of deposits received, 1924. 5 pp. London, 1925. Price 2d. net. (H.M. Stationery Office.)

England and Wales—

Agriculture and Fisheries, Ministry of :—

Report upon large-scale co-operative marketing in the United States of America. By *F. B. Forrester*. (Economic Series No. 4.) viii + 192 pp. London, 1925. Price 1s. 6d. net.

The co-operative purchase of agricultural requisites. A survey of the present position in England and Wales. (Economic Series No. 5.) iii + 110 pp. London, 1925. Price 1s. 6d. net.

Report on the trade in refrigerated beef, mutton and lamb. (Economic Series No. 6.) vi + 65 pp. London, 1925. Price 1s. 6d. net.

Land settlement in England and Wales, 1919–24. 150 pp. London, 1925. Price 2s. 6d. net. (The Ministry.)

Health, Ministry of. Reports on Public Health and Medical Subjects. No. 32: A further report on cancer of the breast, with special reference to its associated antecedent conditions. By *Janet E. Lane-Claypon*, *M.D., D.Sc. (Lond.)*. x + 189 pp. London, 1926. Price 3s. net. No. 33: A study in vocational guidance, carried out by the Industrial Fatigue Research Board and the National Institute of Industrial Psychology. viii + 106 pp. London, 1926. Price 4s. net. No. 34: A contribution to the study of the human factor in the causation of accidents. By *E. M. Newbold, B.A.*. v + 74 pp. London, 1926. Price 5s. net. (Ministry of Health.)

Stepney—

Electricity supply undertaking. Abstract of accounts and balance sheet, 1925. viii + 18 pp. 1925. (Mr. J. E. Dodsworth.)

(b) India and Dominions.

India—

Commercial Intelligence and Statistics, Department of. Rail-borne trade at stations adjacent to land frontier routes, December, 1925. (Supplement to the "Indian Trade Journal," January 28, 1926.) 4 pp. Calcutta, 1926. (The Department.)

Indian Currency Committee, 1898. Index and appendices to the evidence taken before the Committee. 190 pp. and diagrams, fol. London, 1899. Price 3s. 9d. C. 9376. (Mr. Finch.)

United Provinces of Agra and Oudh. District Gazetteers. Supplementary notes and statistics. Vol. IV: Meerut District. 14 + xlviii pp. Price 14 annas. V: Bulandshahr District. 15 + xxxvi pp. Price 12 annas. VIII: Agra District. 17 + lxii pp. Price Re. 1. XLIII: Fyzabad District. 27 + liii pp. Price Re. 1. 4 parts. Allahabad, 1925. (High Commissioner for India in London.)

Australia—

Census, 1921. Part XXIV: Dwellings—territories. pp. 1695–1710. XXV: Dwellings. pp. 1713–1816. XXVI: Tropical and non-tropical regions of Australia. pp. 1820–1833. 3 parts, fol. Melbourne, 1925. Price 2s. 6d. each part. (The Bureau.)

New South Wales—

Report, resolutions and agenda of the Conference of Statisticians, held at Sydney, October 26–30, 1925. 10 pp., fol. Sydney, 1925. (Government Statistician, Melbourne.)

Western Australia—

Official Handbook, 1925. 264 pp. Perth, 1925. (The Agent-General for Western Australia in London.)

Bermuda—

Census, 1921. 1 vol. (Colonial Office.)

Canada—

Labour, Department of. Report of Provincial Royal Commission on Coal-Mining Industry in Nova Scotia. 31 pp. Ottawa, 1926.

Prices in Canada and other countries. 30 pp. Ottawa, 1926.

Wages and hours of labour in Canada, 1920–25. Report No. 9. 45 pp. Ottawa, 1926. Supplements to the "Labour Gazette," January, 1926. (The Department.)

Statistics, Dominion Bureau of. Economic position of the Canadian prairie provinces in 1923. 14 pp., fol. Typed. Ottawa, 1926. (The Bureau.)

New Zealand—

Census and Statistics Office. Census, 1921. General report. xi + 232 pp., fol. Wellington, 1925. Price 5s. (The Office.)

(c) Foreign Countries.

Denmark—

- Ansættelserne til Indkomst- og Formueskatten, 1924-25. 2. Afdeling. Fordeling efter Indkomstens og Formuens Størrelse. 79 pp. København, 1925. Price Kr. 0.75. (Statistiske Departement.)
 Kapitelstakster, 1925. 12 pp. København, 1926. Price Kr. 0.35. (*Id.*)
 Skovbruget, 1923. 110 pp. 1925. Price Kr. 1.00. (*Id.*)
 Folketællingen, 1921. 142 + 190 pp., 4to. København, 1925. Price Kr. 4.00. (Mr. Finch.)

France—

- Conseil supérieur du travail, 1924. Enquête sur le règlement amiable des conflits collectifs du travail. Extraits des procès-verbaux. xix + 136 pp. Paris, 1925. (Ministère du Travail.)
 Renseignements généraux sur le commerce des colonies françaises et la navigation, 1923. 301 pp. Paris, 1925. (Ministère des Colonies.)

Germany—

- Einkommensteuergesetz vom 24 Juni, 1891, nebst Ausführungsanweisung vom 5 August, 1891. 1 vol. Berlin: Reichsdruckerei, 1891. (Mr. Finch.)
 Die Güterbewegung auf deutschen Eisenbahnen, 1924. xvii + 418 pp. Berlin, 1926. Price 40 Reichsmark. (Statistisches Reichsamt.)
Frankfurt a/M.—
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Exports: Declared value of U.K. Produce and Manufactures, and of Foreign and Colonial Merchandise, exported from the United Kingdom in the year ended December 31, 1925, compared with 1924 and 1923.

Countries to which consigned.	1923.		1924.		1925.	
	Exports.	Re-exports.	Exports.	Re-exports.	Exports.	Re-exports.
	£'000.	£'000.	£'000.	£'000.	£'000.	£'000.
Russia	2,492,	1,989,	3,860,	7,212,	6,166,	13,269,
Finland	3,911,	921,	4,558,	1,019,	3,959,	699,
Sweden	13,798,	1,832,	13,869,	1,811,	11,508,	1,743,
Norway	8,591,	780,	8,721	646,	8,104,	787,
Denmark,* with Faroe Islands	12,534,	1,718,	13,799,	1,710,	10,986,	1,227,
Poland, including Dantzic	2,722,	973,	3,500,	1,507,	3,708,	889,
Germany	42,624,	18,272,	42,587,	23,930,	44,206,	27,283,
Netherlands*	29,499,	5,834,	25,220,	7,311,	24,836,	6,836,
Java	6,997,	79,	6,885,	74,	8,408,	91,
Belgium*	25,234,	10,219,	22,668,	10,215,	18,674,	10,267,
France*	49,258,	19,041,	41,715,	17,766,	31,042,	23,235,
Switzerland	7,289,	1,355,	11,807,	1,394,	9,204,	1,181,
Portugal*	4,808,	654,	4,519,	899,	4,172,	685,
Spain*	10,523,	796,	10,479,	899,	10,271,	763,
Italy*§	19,409,	2,145,	17,670,	2,371,	18,824,	2,868,
Czechoslovakia	994,	107,	1,876,	156,	1,560,	231,
Greece	3,822,	132,	5,867,	151,	6,016,	157,
Roumania	2,772,	71,	2,857,	82,	3,071,	115,
Turkey, European and Asiatic, incl. Smyrna and Armenia ...	3,930,	175,	4,216,	132,	4,600,	211,
Egypt	15,073,	241,	15,118,	260,	16,441,	257,
China†	18,634,	171,	20,347,	191,	14,555,	176,
Japan†	26,319,	254,	26,705,	305,	16,356,	264,
United States	59,700,	25,943,	53,842,	24,585,	52,069,	31,166,
Cuba	2,932,	124,	3,194,	126,	2,607,	81,
Mexico	2,752,	60,	2,425,	52,	3,137,	59,
Peru	2,531,	73,	2,734,	69,	2,384,	75,
Chile	6,706,	305,	5,355,	314,	6,028,	308,
Brazil	10,997,	253,	13,612,	497,	16,145,	332,
Uruguay	3,146,	112,	3,208,	53,	3,168,	72,
Argentine Republic	28,138,	694,	27,204,	498,	29,177,	597,
Other countries	38,471,	2,379,	43,947,	2,240,	46,784,	2,168,
Total—Foreign Countries ...	466,655,	97,652,	463,364,	113,480,	438,166,	128,092,
BRITISH POSSESSIONS.						
Irish Free State	24,639,	6,574,	47,297,	11,216,	40,162,	10,964,
British West Africa	11,507,	996,	10,487,	1,154,	13,942,	1,383,
Union of South Africa	27,844,	1,440,	30,405,	1,596,	30,668,	1,652,
British East Africa	2,931,	69,	3,664,	116,	5,188,	169,
British India, with Burmah ...	86,246,	1,096,	90,577,	1,114,	85,944,	1,194,
Straits Settlements and Federated Malay States	8,608,	188,	9,463,	203,	13,514,	327,
Ceylon and Dependencies	3,764,	105,	4,310,	125,	5,044,	155,
Australia	57,700,	4,175,	60,760,	5,159,	60,168,	3,863,
New Zealand	20,696,	1,005,	20,333,	1,025,	23,097,	1,111,
Canada	27,553,	2,749,	28,132,	2,450,	27,562,	3,131,
Brit. W. Indies, with Bahamas	4,637,	636,	4,247,	339,	4,501,	311,
Other Possessions	24,472,	1,858,	27,928,	1,993,	25,131,	2,059,
Total—British Possessions	300,602,	20,891,	337,603,	26,490,	334,921,	26,319,
Total—Foreign Countries and British Possessions ...	767,257,	118,543,	800,967,	139,970,	773,086,	154,411,

* Excluding colonies.

† Excluding Hong Kong, Macao, and leased territories.

‡ Including Formosa and leased territories; excluding Korea.

§ Including Fiume from 1924.

|| From April 1, 1923, only.

Imports.—Declared Value of Merchandise imported into the United Kingdom in the years ended December 31, 1925, compared with 1924 and 1923.

Countries whence consigned.	1923.	1924.	1925.
	£'000.	£'000.	£'000.
Russia	9,266	19,774	25,329
Finland	13,205	13,804	13,223
Sweden	21,530	22,505	21,317
Norway	11,127	11,605	12,973
Denmark,* with Faroe Islands	46,203	48,904	49,266
Poland, including Dantzic	5,362	8,320	5,143
Germany	34,994	36,888	48,156
Netherlands*	37,061	42,735	45,586
Java	11,029	8,866	9,441
Belgium*	27,476	36,387	35,556
France*	58,462	66,578	65,062
Switzerland	19,426	19,436	19,033
Portugal*	3,954	4,691	4,776
Spain*	19,577	19,649	19,658
Italy*§	14,295	18,228	19,415
Czechoslovakia	8,300	13,473	10,737
Greece	4,697	3,664	2,860
Roumania	2,354	2,209	2,278
Turkey, European and Asiatic, including Smyrna|| .....	3,146	3,155	2,446
Egypt	33,062	38,264	34,235
China†	12,161	13,915	13,739
Japan†	6,767	7,470	7,344
United States	210,724	241,190	247,247
Cuba	8,748	12,511	11,620
Mexico	6,348	5,837	5,323
Peru	8,607	9,764	8,511
Chile	5,741	10,689	12,276
Brazil	5,873	4,783	5,943
Uruguay	4,855	5,449	4,867
Argentine Republic	64,948	78,955	68,544
Other countries	50,981	59,868	61,233
Total—Foreign Countries	770,299	889,566	893,137
BRITISH POSSESSIONS.			
Irish Free State	33,728	51,096	43,394
British West Africa	11,168	13,264	13,784
Union of South Africa	15,354	18,080	25,197
British East Africa	3,731	5,340	7,877
British India, with Burma	66,930	78,873	79,977
Straits Settlements and Federated Malay States	12,938	12,227	23,791
Ceylon and Dependencies	12,452	13,596	17,058
Australia	49,005	59,022	72,740
New Zealand	42,966	46,964	51,332
Canada	53,380	65,900	70,727
British West Indies, with Bahamas	5,886	4,823	5,967
Other Possessions	19,369	18,688	17,877
Total—British Possessions	325,927	387,873	429,721
Total — Foreign Countries and British Possessions	1,096,226	1,277,439	1,322,858

* Excluding colonies. † Excluding Hong Kong, Macao, and leased territories.

‡ Including Formosa and leased territories; excluding Korea.

§ Including Fiume from 1924.

¶ From April 1, 1923, only.

|| Including Armenia from 1924.

PERIODICAL RETURNS.

REGISTRATION OF THE UNITED KINGDOM.

No. I.—ENGLAND AND WALES.

BIRTHS, DEATHS AND MARRIAGES—To 31st DECEMBER, 1925.

A.—*Serial Table of BIRTHS, DEATHS, and MARRIAGES, returned in the Years 1925-1919, and in the QUARTERS of those Years.**Calendo* · YEARS. 1925-1919 :—Numbers.

Years	1925.*	'24.	'23.	'22.	'21.	'20	'19
Births No.	710,979	729,933	758,131	780,124	848,814	957,782	692,438
Deaths ..	473,006	473,235	444,785	436,780	453,629	466,130	504,203
Marriages ..	295,166	296,416	292,408	299,524	320,852	379,932	369,411

QUARTERS of each Calendar Year, 1925-1919.

(I.) BIRTHS:—Numbers.

<i>Qrs. ended last day of</i>	1925.*	'24.	'23.	'22.	'21.	'20.	'19.
March No	175,646	185,389	192,892	207,539	209,579	270,965	144,789
June ..	186,974	187,038	196,754	200,524	225,301	248,616	148,761
September ..	181,943	186,579	190,062	195,718	214,806	229,785	175,307
December ..	166,416	170,927	178,423	176,343	199,128	208,416	223,581

(II) DEATHS:—Numbers

<i>Qrs. ended last day of</i>	1925.*	'24.	'23.	'22.	'21.	'20.	'19.
March No.	138,338	160,274	124,711	165,493	129,273	137,616	191,917
June ..	113,267	114,188	114,044	120,302	108,469	119,271	108,439
September ..	95,127	90,138	91,250	90,927	99,096	93,672	89,087
December ..	126,274	108,635	114,780	110,058	121,791	115,571	114,760

(III.) MARRIAGES:—Numbers.

<i>Qrs. ended last day of</i>	1925.*	'24.	'23.	'22.	'21.	'20.	'19.
March No	46,185	47,068	53,316	50,382	76,158	69,201	60,203
June ..	81,779	81,301	74,929	82,817	71,328	108,797	101,252
September ..	90,158	89,841	87,289	89,730	89,477	109,947	106,294
December ..	77,044	78,206	76,874	76,595	83,889	92,037	101,662

* Provisional.

Annual Rates of BIRTHS, DEATHS, and PERSONS MARRIED, per 1,000 PERSONS LIVING in the Years 1925-1918, and in the QUARTERS of those Years.

Calendar YEARS, 1925-1918 :—General Ratios.

YEARS....	1925 †	'24.	'23.	'22	'21.	'20.	'19.	'18.
Estd. Popln. of England and Wales in thousands in middle of each Year	38,890,	38,746,	38,403,	38,158,	37,887,	37,247,*	35,427,*	34,024,*
Births	18·3	18·8	19·7	20·4	22·4	25·5	18·5	17·7
Deaths.....	12·2	12·2	11·6	12·8	12·1	12·4*	14·0*	17·3*
Persons Married	15·2	15·3	15·2	15·7	16·9	20·2	19·8	15·3

QUARTERS of each Calendar Year, 1925-1918.

(I.) BIRTHS:—Ratio per 1,000.

Qrs. ended last day of	1925 †	'24.	'23.	'22.	'21.	'20.	'19.	'18.
March	18·3	19·2	20·4	22·1	22·4	29·2	15·7	17·6
June.....	19·3	19·4	20·5	21·1	23·9	26·5	16·0	18·2
September	18·6	19·1	19·6	20·3	22·5	24·2	18·6	17·8
December	17·0	17·5	18·4	18·3	20·9	22·0	23·7	17·1

(II.) DEATHS:—Ratio per 1,000.

Qrs. ended last day of	1925.†	'24.	'23.	'22.	'21.	'20.	'19.	'18.
March	14·4	16·6	13·2	17·6	13·8	14·7*	21·3*	16·1*
June.....	11·7	11·8	11·9	12·6	11·5	12·8*	12·1*	13·5*
September	9·7	9·2	9·4	9·5	10·4	10·0*	9·9*	12·8*
December	12·9	11·1	11·9	11·4	12·8	12·3*	12·8*	26·6*

(III.) PERSONS MARRIED :—Ratio per 1,000.

Qrs. ended last day of	1925.†	'24.	'23.	'22.	'21.	'20.	'19.	'18.
March	9·6	9·7	11·3	10·7	16·3	14·8	13·1	14·2
June.....	16·9	16·8	15·6	17·4	15·1	23·3	21·7	14·4
September	18·4	18·4	18·0	18·7	18·7	23·2	22·6	16·7
December	15·7	16·0	15·8	15·9	17·6	19·5	21·6	15·9

* Civilians only.

† Provisional figures.

B.—Special Town Table:—POPULATION; BIRTH-RATE and Civilian DEATH-RATE in each Quarter of 1925, in certain of the 105 County Boroughs and Great Towns.

Cities and boroughs.	Estimated population mid 1924.	Annual Rate to 1,000 Living during the thirteen weeks ending							
		March 31 1925. (1st quarter.)		June 30, 1925. (2nd quarter.)		Sept. 27, 1925. (3rd quarter.)		Jan. 3, 1926. ^r (4th quarter.)	
		Births.	Deaths.	Births.	Deaths.	Births.	Deaths.	Births.	Deaths.
105 county boroughs and towns	19,358,825 [†]	19.3	14.6	19.9	11.4	19.0	9.6	17.6	13.4
<i>Including—</i>									
London	4,576,505*	19.1	14.1	19.3	10.1	18.5	9.1	16.9	13.6
West Ham, C.B.	317,400	25.9	12.4	25.7	8.9	24.3	8.9	23.4	12.1
Croydon, C.B.	196,000	17.0	12.9	18.4	9.5	19.4	8.3	16.9	12.9
† Brighton, C.B.	137,500*	17.8	15.9	17.8	11.1	17.0	10.4	14.6	13.9
Portsmouth, C.B.	232,000	19.3	13.5	21.3	11.6	18.9	9.8	18.4	13.6
Bristol, C.B.	386,200*	17.3	15.8	18.8	14.0	18.8	9.8	16.7	13.5
Cardiff	226,200*	21.9	15.4	23.0	11.5	21.0	10.4	19.8	13.1
Swansea	162,700	21.1	12.7	21.8	12.1	20.7	9.6	18.6	10.6
Wolverh'ton, C.B.	108,200	19.7	15.4	22.5	11.8	19.1	8.9	20.1	12.5
Birmingham, C.B.	946,980	18.8	13.7	20.6	11.1	19.9	9.3	17.9	12.2
Norwich	123,900*	18.8	15.8	19.0	10.1	18.0	8.5	16.7	13.4
Leicester	241,800	19.2	15.3	19.5	12.4	17.3	10.3	15.6	13.2
Nottingham, C.B.	270,300	20.3	16.7	20.2	11.8	18.0	10.2	18.0	15.0
Derby, C.B.	133,700*	25.6	13.6	19.7	12.2	18.7	8.0	17.3	11.9
Birkenhead, C.B.	154,100	20.8	13.9	22.0	10.3	21.6	9.1	18.6	13.1
Liverpool, C.B.	851,800	22.8	16.9	24.0	13.1	22.9	10.5	22.2	14.4
Bolton, C.B.	181,100	16.3	16.1	15.9	12.8	17.8	10.8	14.9	13.7
Manchester, C.B.	755,000	19.6	16.9	20.8	13.2	20.0	11.0	17.5	15.7
Salford, C.B.	243,700	19.0	16.8	19.8	12.1	18.3	9.4	17.3	14.9
Oldham, C.B.	147,300	15.0	17.6	16.0	12.2	15.4	11.8	15.0	16.9
Burnley, C.B.	103,400	17.8	18.7	15.2	14.5	17.4	9.4	14.0	13.6
Blackburn, C.B.	127,600	15.7	16.8	16.1	12.4	15.3	10.2	14.0	15.1
Preston, C.B.	123,100	17.0	17.0	18.8	13.7	18.5	10.8	18.4	15.3
Huddersfield, C.B.	112,000	13.0	14.1	16.1	12.5	16.1	10.9	14.3	14.8
Halifax, C.B.	98,750*	15.6	18.7	16.7	15.5	14.5	11.7	14.4	14.3
Bradford, C.B.	290,200	16.8	17.3	17.9	13.5	16.7	10.2	15.7	14.0
Leeds, C.B.	471,600	18.0	14.5	19.9	11.0	18.2	10.6	16.5	14.1
Sheffield, C.B.	525,000	18.2	12.7	18.4	11.4	17.7	8.8	17.8	13.1
Hull, C.B.	296,800	19.8	15.4	21.9	12.1	21.2	10.7	18.3	14.1
Sunderland, C.B.	165,100	27.1	16.1	26.7	16.2	24.6	13.7	22.7	14.8
Gateshead, C.B.	123,700	22.9	16.3	23.6	14.1	23.5	11.0	21.6	13.6
Newcastle-on-Tyne, C.B. }	285,900*	24.7	15.0	25.6	13.6	25.2	10.8	22.7	14.2

* Excluding non-civilians.

† Fourteen weeks.

‡ Figures refer to the borough as extended, Oct. 1, 1923.

Note.—The 105 great towns are those with populations exceeding 50,000 persons at the Census of 1921.

No. II.—SCOTLAND.

BIRTHS, DEATHS, AND MARRIAGES, IN THE YEAR

ENDED DECEMBER 31, 1925.

I.—Serial Table:—Number of BIRTHS, DEATHS, and MARRIAGES in Scotland, and their Proportion to the Population estimated to the Middle of each Year, during each Quarter of the Years 1925-1921 inclusive.

	1925.		1924.		1923.		1922.		1921.	
	Number.	Per 1,000.	Number.	Per 1,000.	Number.	Per 1,000.	Number.	Per 1,000.	Number.	Per 1,000.
1st Quarter—										
Births	25,232	20·9	27,452	22·7	28,530	23·6	30,854	25·5	29,824	24·8
Deaths	18,349	15·2	21,967	18·1	17,671	14·6	26,263	21·7	19,940	16·6
Marriages ..	7,647	6·3	7,302	6·0	8,083	6·7	7,838	6·5	10,934	9·1
2nd Quarter—										
Births	27,909	22·9	27,985	23·1	29,140	23·8	30,046	24·6	33,473	27·5
Deaths	15,911	13·0	17,872	14·8	16,321	13·3	17,768	14·5	16,122	13·2
Marriages ..	8,017	6·6	7,977	6·6	8,881	7·3	8,717	7·1	9,459	7·8
3rd Quarter—										
Births	25,593	20·8	26,175	21·4	27,087	21·9	28,019	22·7	30,083	24·4
Deaths	18,449	10·9	13,703	11·2	13,172	10·7	13,179	10·7	13,971	11·4
Marriages ..	9,140	7·4	9,147	7·5	9,872	8·0	9,381	7·6	9,756	7·9
4th Quarter—										
Births	25,403	20·6	25,288	20·7	27,145	22·0	26,166	21·2	29,821	24·2
Deaths	17,796	14·4	16,815	13·7	16,119	13·0	15,695	12·7	16,177	13·1
Marriages ..	7,664	6·2	7,926	6·5	8,364	6·8	8,339	6·8	9,094	7·4
Year—										
Population.	4,891,300		4,881,637		4,901,100		4,904,456		4,882,497	
Births	104,137	21·3	106,900	21·9	111,902	22·8	115,085	23·5	123,201	25·2
Deaths	65,505	13·4	70,357	14·4	63,283	12·9	72,905	14·9	66,210	13·6
Marriages ..	32,468	6·6	32,352	6·6	35,200	7·2	34,375	7·0	39,243	8·0

I.—*Special Average Table:—Number of Births, Deaths, and Marriages in Scotland and in the divisions of the counties during each Quarter of 1925, and their proportion to the population.*

Registration group of districts.	Total Births.		Deaths.		Marriages	
	Number.	Per 1,000 of population.	Number.	Per 1,000 of population.	Number.	Per 1,000 of population.
1st quarter—SCOTLAND	25,232	20·9	18,347	15·2	7,647	6·3
Northern division	293	13·5	388	17·9	106	4·9
North Western div.....	569	16·0	623	17·6	175	4·9
North Eastern div.	2,312	21·6	1,641	15·4	621	5·8
East Midland div.	3,487	19·6	2,819	15·8	1,025	5·7
West Midland div.	1,931	18·5	1,427	13·7	571	5·5
South Western div.....	12,500	23·0	7,861	14·5	3,681	6·8
South Eastern div.	3,260	18·8	2,716	15·7	1,248	7·2
Southern div.	880	19·9	872	19·7	220	5·0
2nd quarter—SCOTLAND	27,909	22·9	15,902	13·0	8,017	6·6
Northern division	392	17·9	345	15·8	101	4·6
North Western div.....	645	18·0	545	15·2	172	4·8
North Eastern div.	2,530	23·4	1,425	13·2	732	7·2
East Midland div.	3,781	21·0	2,412	13·4	1,000	5·6
West Midland div.	2,199	20·9	1,239	11·8	489	4·6
South Western div.....	13,729	25·0	6,922	12·6	3,738	6·8
South Eastern div.	3,674	21·0	2,326	13·3	1,414	8·1
Southern div.	959	21·5	687	15·4	321	7·2
3rd quarter—SCOTLAND	25,593	20·8	13,449	10·9	9,140	7·4
Northern division	363	16·4	288	13·0	90	4·1
North Western div.....	628	17·3	442	12·2	108	3·0
North Eastern div.	2,370	21·7	1,202	11·0	810	7·4
East Midland div.	3,361	18·4	2,002	11·3	1,256	6·9
West Midland div.	1,946	18·3	1,092	10·3	570	5·4
South Western div.....	12,540	22·6	5,899	10·6	4,380	7·9
South Eastern div.	3,468	19·6	1,983	11·2	1,657	9·4
Southern div.	917	20·3	536	11·9	269	6·0
4th quarter—SCOTLAND	25,403	20·6	17,796	14·4	7,664	6·2
Northern division	390	17·6	339	15·3	131	5·9
North Western div.....	616	17·0	546	15·1	177	4·9
North Eastern div.	2,317	21·2	1,512	13·8	875	8·0
East Midland div.	3,409	18·7	2,632	14·4	1,058	5·8
West Midland div.....	1,917	18·0	1,317	12·4	465	4·4
South Western div.....	12,515	22·6	7,293	13·2	3,398	6·1
South Eastern div.	3,421	19·3	2,553	14·4	1,273	7·2
Southern div.	817	18·1	704	15·6	287	6·3

Population of Scotland.

Population.	Scotland.	Northern division.	North Western division.	North Eastern division.	East Midland division.	West Midland division.	South Western division.	South Eastern division.	Southern division.
By Census of 1911	4,760,904	105,997	164,636	467,333	712,146	388,312	2,033,521	700,577	190,382
1921	4,882,497	95,718	153,273	450,441	728,985	423,153	2,137,619	704,011	188,297
Estimated to mid 1925	4,891,300	87,700	143,800	433,500	723,400	422,200	2,199,400	702,000	179,300

No. III.—NORTHERN IRELAND.

NORTHERN IRELAND.—*Number of Births, Deaths and Marriages for each Quarter of 1925 and their Proportion to the Population.*

Quarters ended last day of—	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 of population	Number.	Annual rate per 1,000 of population	Number.	Annual rate per 1,000 of population
1st quarter	6,862	21·4	6,274	19·6	1,449	4·5
2nd „	7,414	23·2	4,913	15·3	1,940	6·1
3rd „	7,124	22·2	3,858	12·0	2,253	7·0
4th „	6,373	19·9	4,750	14·8	2,079	6·5
Total for year 1925	27,773	21·7	19,795	15·4	7,721	6·0

Population of Northern Ireland, estimated to mid 1925 (inclusive of military):—1,281,000.

NORTHERN IRELAND.

	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.
1st quarter, 1925—						
Total rural districts	2,957	17·9	3,406	20·6	—	—
*Total urban districts	3,905	26·4	2,868	19·4	—	—
Belfast co. borough	2,564	23·5	1,847	16·9	—	—
Londonderry co. borough ...	329	27·5	223	18·6	—	—
2nd quarter—						
Total rural districts	3,244	19·7	2,719	16·5	—	—
*Total urban districts	4,170	28·2	2,194	14·9	—	—
Belfast co. borough	2,749	25·2	1,838	12·7	—	—
Londonderry co. borough ...	318	26·6	159	13·3	—	—
3rd quarter—						
Total rural districts	3,158	19·1	2,060	12·5	—	—
*Total urban districts	3,966	26·8	1,798	12·2	—	—
Belfast co. borough	2,582	23·6	1,173	10·7	—	—
Londonderry co. borough ...	336	28·1	127	10·6	—	—
4th quarter—						
Total rural districts	2,861	17·3	2,251	13·6	—	—
*Total urban districts	3,512	23·8	2,499	16·9	—	—
Belfast co. borough	2,339	21·4	1,723	15·8	—	—
Londonderry co. borough ...	295	24·7	160	13·4	—	—

* Including county boroughs.

No. IV.—IRISH FREE STATE.

Number of Births, Deaths and Marriages in the Irish Free State for each quarter of the year 1925, and their proportion to the population.

Births.				Deaths.		Marriages.	
	Number.	Annual rate per 1,000 of population		Number.	Annual rate per 1,000 of population	Number.	Annual rate per 1,000 of population
1st quarter . . .	15,380	19·4	13,091	16·6	4,160	5·3	
2nd „ . . .	16,434	20·6	11,738	14·8	3,377	4·3	
3rd „ . . .	15,883	20·1	9,055	11·5	3,511	4·4	
4th „ . . .	14,270	18·0	9,994	12·5	2,975	—	
Total year, 1925 .	61,967	19·6	43,778	13·8	14,023	—	

Population of the Free State estimated to mid 1925 :—3,163,000.

IRISH FREE STATE.

	Births.		Deaths.		Marriages.	
	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.	Number.	Annual rate per 1,000 persons.
1st quarter, 1925—						
Total rural districts	9,945	17·5	9,318	16·4	—	—
Total urban „	5,435	24·5	3,773	17·0	—	—
Dublin registration area	2,806	25·6	1,968	18·0	—	—
Cork City	484	25·3	350	18·3	—	—
2nd quarter—						
Total rural districts	10,950	19·2	8,617	15·1	—	—
Total urban „	5,494	24·8	3,121	14·1	—	—
Dublin registration area	2,891	26·4	1,641	15·0	—	—
Cork City	473	24·7	271	14·1	—	—
3rd quarter—						
Total rural districts	10,559	18·5	6,277	11·0	—	—
Total urban „	5,324	24·0	2,778	15·5	—	—
Dublin registration area	2,698	24·0	1,469	13·4	—	—
Cork City	497	25·9	264	13·8	—	—
4th quarter—						
Total rural districts	9,675	17·0	6,784	11·9	—	—
Total urban „	4,595	20·7	3,110	14·0	—	—
Dublin registration area	2,331	21·3	1,659	15·2	—	—
Cork City	373	19·5	300	15·7	—	—

No. V.—GREAT BRITAIN AND IRELAND.

SUMMARY of BIRTHS, DEATHS and MARRIAGES, in the Year 1925.

(Compiled from the Quarterly Returns of the respective Registrars-General.)

Countries.	[000's omitted.]		Buths.	Per 1,000 of popula- tion.	Deaths.	Per 1,000 of popula- tion.	Mar- riages.	Per 1,000 of popula- tion.
	Area in statute acres.	Popula- tion middle 1925, estimated						
England and } Wales }	37,338	38,890	No. 710,979	Ratio. 18·8	No. 473,006	Ratio. 12·2	No. 295,166	Ratio. 15·2
Scotland ...	19,070	4,891	104,137	21·3	65,505	13·4	32,468	6·6
Northern Ire- land	3,352	1,281	27,773	21·7	19,795	15·4	7,721	6·0
Great Britain } and North- ern Ireland }	59,940	45,062	842,889	18·7	558,306	12·4	335,355	7·4

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THE GROWTH OF MORTALITY DUE TO MOTOR VEHICLES IN ENGLAND AND WALES, 1904-23.

By MAJOR P. GRANVILLE EDGE, O.B.E.

[Read before the Royal Statistical Society, March 16, 1926,
the President, Mr. G. UDNY YULE, C.B.E., F.R.S., in the Chair.]

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Introduction.

FROM time to time public opinion is aroused by the daily press, demanding that the national health authorities shall give special attention to this or that disease; a fine sense of concern is displayed; we are told something effective must be done to stem the rising tide of mortality; columns are devoted to the discussion of the various

aspects of the subject; eminent "authorities" are interviewed; and, in a day or two, the matter is dropped.

One danger to health has indeed a permanent news value. The general public is never allowed to forget that cancer mortality has steadily increased in the past twenty years, and that special efforts are being made, and intensive investigations are in progress, with a view to discovering a means of reducing the present high mortality resulting from this disease.

Cancer mortality is fairly continuously pressed upon the attention of the nation, but another cause of increasing mortality passes, not indeed without comment, even indignant comment, but without continuous public attention. Yet the deaths arising from street accidents mount up year by year. Each year the traffic problem presents increasing difficulties to be overcome by local administrative authorities; the effects of the increasing congestion on our streets and roads is reflected in the official returns of deaths caused by motor and other road vehicles.

Mortality caused by horse-drawn vehicles compared with mortality due to motor vehicles.

In this paper I have attempted to focus some of the available statistical information: for its purposes, deaths due to mechanically propelled road vehicles have been considered. In the following table the numbers of deaths caused by horse-drawn vehicles and by motor traffic in twenty years are compared:—

Year.	Deaths caused by	
	Horse-drawn vehicles.	Mechanically propelled vehicles.
1904	1,103	171
1905	1,059	172
1906	1,089	265
1907	518	365
1908	565	421
1909	474	395
1910	405	524
1911	490	735
1912	526	888
1913	503	1,104
1914	438	1,325
...		
...	War years.	...
...		
1919	344	1,711
1920	297	1,948
1921	272	1,989
1922	296	2,087
1923	271	2,414

How serious is the increase in the numbers of deaths caused by motor road vehicles in England and Wales may be gathered from the fact that, whereas the cancer deaths in 1923 were $1\frac{1}{2}$ times more numerous than those of 1904, the deaths caused by motor vehicles in 1923 were 14 times the numbers assigned to this cause in 1904. In other words, mechanically propelled vehicles claimed approximately 0.5 victims per day in 1904, or 3.3 per week; and in 1923, 7 victims a day, or 50 a week; the rate of annual increase of mortality is probably greater than has ever been attributed to any other single cause. Further, and as an additional measure of comparison, it may be stated that scarlet-fever deaths were approximately one-third, deaths attributable to enteric fever one-sixth, of the numbers of deaths due to motor traffic during 1923. It should be remembered that during the period under review (1904-23) the mortality rate of deaths from *all causes* diminished by over 11 per cent., and the mortality rate arising from deaths caused by horse-drawn vehicles decreased by approximately 80 per cent.; during the same period the cancer mortality rate increased approximately 50 per cent., and the mortality arising from accidents caused by mechanically propelled vehicles by over 1,000 per cent.

Mortality rates, England and Wales, per 100,000 living.

Year.	Deaths. All causes.	Cancer.	Deaths. Motor traffic.	Deaths. Horse-drawn vehicles.
1904	1,630	88	0.5	3.3
1905 ...	1,530	89	0.5	3.1
1906	1,550	92	0.8	3.2
1907 ...	1,510	92	1.1	1.5
1908 ...	1,480	93	1.2	1.6
1909 ..	1,460	96	1.1	1.3
1910 ...	1,350	97	1.4	1.1
1911 ..	1,460	99	2.0	1.4
1912 ...	1,330	102	2.4	1.5
1913 ...	1,380	106	3.1	1.4
1914	1,400	107	3.6	1.2
...
1919 ..	1,370	112	4.6	0.9
1920 ...	1,240	116	5.2	0.8
1921 ..	1,210	121	5.5	0.7
1922 ..	1,280	123	5.4	0.8
1923	1,160	126	6.3	0.7

I have attempted to smooth the rough figures, and find that, if x = the absolute number of motor fatalities, and t = the time in years measured from the year 1909 (see col. (3), table below),

the equation $\log x = 2.6704 + .090496t - .000003t^2$ is a fairly good representation of the data for 1904-14. This equation, however, used for extrapolation, greatly over-estimates the numbers of deaths for 1919 and onwards. The quadratic term was modified to secure better extrapolation, and the equation became

$$\log x = 2.6704 + .090496t - .0031t^2.$$

This, as will be seen from col. (4), also gives a fair representation, but it is too optimistic to believe that it is more than a graduation formula, since, according to it, the deaths will begin to decrease in, or about, 1924.

Motor fatalities, 1904-23.

(1) Year.	(2) Observed.	(4) Calculated.	
		(3) ($\log x = 2.6704 + .090496t - .000003t^2$)	(4) ($\log x = 2.6704 + .090496t - .0031t^2$)
1904	171	165	138
1905	172	203	181
1906	265	251	235
1907	365	309	300
1908	421	380	377
1909	395	468	468
1910	524	577	573
1911	735	710	690
1912	888	875	820
1913	1,104	1,077	961
1914	1,325	1,327	1,110
...
1919	1,711	3,759	1,842
1920	1,948	4,629	1,953
1921	1,989	5,700	2,040
1922	2,087	7,019	2,135
1923	2,414	8,644	2,137
(1930)	—	—	1,599)

It is, of course, obvious that rates of mortality cannot increase or decrease indefinitely. In the special case of motor fatalities, for reasons to be given below, we may be sure that the rate of increase will slacken. I have not, however, succeeded in finding any simple algebraical or exponential function postulating a slackening rate of increase which represents the trend more satisfactorily, and the point is not highly relevant to my argument. I

have no sympathy with the sensational prophet who predicts from existing data future holocausts.

Not the least distressing feature of the mortality due to this cause is the comparatively large number of deaths of children aged 5-10 years :—

Deaths of children aged 5-10 years.

Year.	Actual deaths. Mechanically propelled vehicles.	Percentage of all deaths.	Actual deaths. Horse-drawn vehicles.	Percentage of all deaths, horse-drawn vehicles.
1904	14	8.2	106	9.6
1905	7	4.0	101	9.5
1906	33	12.5	109	10.0
1907	43	11.8	48	9.3
1908	56	13.3	68	12.0
1909	46	11.6	40	8.4
1910	80	15.3	43	10.6
1911	141	19.2	45	9.2
1912 .	150	17.0	55	10.4
1913 .	190	17.2	42	8.3
1914	210	15.8	39	8.8
⋮	⋮	⋮	⋮	⋮
1919 .	299	17.5	30	8.7
1920 .	331	17.0	15	5.0
1921 .	335	16.8	19	7.0
1922 .	342	16.4	19	6.4
1923 .	339	14.0	16	6.0

The decrease in mortality due to horse-drawn vehicles is a result one would naturally expect to find in view of the gradual substitution of motor transport for horse-drawn vehicles, but it will be observed that, while in 1904 over 8 per cent. of all deaths due to motor road accidents were those of children between the ages of 5 and 10 years, in 1923 the proportion had grown to 14 per cent. of the total deaths attributable to the same cause.

Mortality due to motor traffic in London.

So far I have referred only to the mortality due to motor accidents for England and Wales as a whole, but if the investigation is carried further, to include individual towns or areas, it will be found that the mortality experience from this cause follows a similar course. For the present purpose returns for the London area are included, and in the following table are given the total deaths from all causes,

horse-drawn vehicles and from motor traffic, in the Administrative County of London :—

Administrative County of London.

Year.	Deaths due to all causes	Deaths due to horse drawn vehicles	Deaths due to motor traffic
1904	74,990	122	22
1905	73,002	115	36
1906	73,990	131	76
1907	72,127	148	124
1908	70,380	145	162
1909	67,632	123	168
1910	61,756	143	231
1911	67,826	132	291
1912	62,517	145	369
1913	65,030	155	424
1914	64,994	126	493
⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮
1919	59,114	95	575
1920	59,038	64	551
1921	59,259	60	490
1922	61,221	56	596
1923	51,991	43	595

Here again occurs the enormous increase in the number of deaths due to mechanically propelled vehicles. In spite of the fact that the general mortality in London was over 30 per cent. lower in 1923 than in 1904 (actual deaths recorded), deaths caused by motor vehicles in the same area show an increase which approaches 3,000 *per cent.* over the figures recorded for 1904. The mortality rates relating to "all causes," "horse-traffic" and "motor-traffic deaths" are as follows :—

London mortality rates per 100,000 living.

Year.	All causes	Horse traffic deaths	Motor-traffic deaths.
1904	1,640	2.6	0.4
1905	1,550	2.5	0.8
1906	1,560	2.8	1.6
1907	1,520	3.1	2.6
1908	1,460	3.0	3.4
1909	1,490	2.5	3.5
1910	1,370	2.9	4.7
1911	1,520	2.9	6.4
1912	1,380	3.2	8.2

London mortality rates per 100,000 living—Contd.

Year.			All causes.	Horse-traffic deaths.	Motor-traffic deaths.
1913	....	....	1,420	3.4	9.4
1914	...	....	1,430	2.8	11.0
⋮			⋮	⋮	⋮
1919	....	....	1,360	2.2	13.7
1920	....	....	1,240	1.4	12.1
1921	....	....	1,250	1.3	10.9
1922	....	....	1,350	1.2	13.2
1923	....	....	1,140	0.9	10.8

Comparison with mortality experience in America.

In endeavouring to institute comparisons with the United States of America, it should be borne in mind that the American returns of deaths caused by motor vehicles do not ordinarily include deaths caused by motor cycles, though such figures are invariably included in the English returns. For the purposes of approximate comparison, however, the following figures present the mortality rates for all causes of death, and mortality due to motor traffic in the two countries :—

Mortality rates per 100,000 living.

Year.	England and Wales.		United States of America.		
	All causes.	Motor traffic.	All causes.	Motor traffic.	
1906	1,550	0.8	1,570	0.4
1909	1,460	1.1	1,440	1.2
1912	1,330	2.4	1,390	2.9
1914	1,400	3.6	1,350	4.3
⋮		⋮	⋮	⋮	⋮
⋮		⋮	⋮	⋮	⋮
1919	1,370	4.6	1,280	9.4
1922	1,280	5.4	1,180	12.5

Examination of the above figures reveals the fact that, in spite of the deplorable increase in the number of deaths caused by motor traffic in England and Wales, the American experience in this respect is much less favourable than is our own : indeed, it is seen that the increase has not only been much more rapid in the United States,

but also the mortality rate resulting from this cause is more than double that of England and Wales. Higher mortality from this cause in the whole registration area of the United States, compared with England and Wales, is also shared by American cities when compared with English towns, as may be seen from the following figures relating to London and to selected American cities :—

Motor fatalities. Mortality rates per 100,000 living.

Year.	London.	Chicago.	New York.	Boston.	Los Angeles.
1907	2.6	13.2	—	—	—
1909	3.5	10.8	—	—	—
1911	6.4	27.8	—	—	—
1913	9.4	22.4	—	—	—
...
1919	13.7	12.3	14.0	16.8	21.1
1920	12.1	20.5	15.4	13.6	27.1
1922	13.2	22.0	15.3	16.9	29.5
1923	10.8	20.2	15.9	17.1	35.6

In all the cases quoted, the mortality experience from this cause is less favourable in American cities than in London.

The growth of motor traffic.

In considering the problem of motor fatalities in England and Wales, it is necessary to take into account the remarkable growth of motor traffic in the past twenty years, for, as might have been expected, and in view of the enormous increase in the numbers of motor vehicles used, it is evident that the death-rate, which was inconsiderable in 1904 (at which date the motor-car was in the nature of a curiosity), has advanced with the development of the motor vehicle, until, in 1923, we find a rate of 6.3 per 100,000, in which year more than 1,000,000 motor vehicles were using our streets and roads.

Following the results of the 1924 traffic census in London, it was established that, at one point, the volume of traffic amounted to an increase of 31 per cent. over that of 1923, 33 per cent. over 1922, and no less than 60 per cent. over the volume of traffic of 1904, while the average increase over all areas amounted to 12 per cent. over the traffic of 1923. The growth of motor traffic in London is even more remarkable, perhaps. According to the reports of the

Commissioner of Police of the Metropolis, the following were the numbers of motor vehicles licensed in different years :—

Year.	Motor omnibuses.	Motor-cabs.	Tramcars.
1904	31	2	810
1914	3,057	7,260	2,819
1923	5,117	7,674	3,214

Of the different types of motor vehicles using the streets and roads of London, and the proportion which the numbers of such vehicles have to the numbers of vehicles of all kinds, the following figures taken from the Report of the Commissioner of Police of the Metropolis, 1924, are of special interest :—

Type of vehicle.	Percentage of total traffic.
Motor-cars (including cabs)	36
Motor omnibuses	17·3
Heavy motor-cars	7·8
Tramcars	4·7
Motor cycles and cycles	20·8

According to these figures, over 80 per cent. of the total traffic of London was provided by mechanically propelled vehicles. The numbers of motor vehicles licensed and registered by the London County Council are given for each year for the period 1904-23 on p. 429. Reference to that table indicates that there were approximately forty times more motor vehicles licensed by that authority in 1923 than in 1904. During the period 1904-23, passenger traffic on trams, omnibuses, and railways, in the London area, shows remarkable increases, and here again we have another factor which no doubt plays its part in producing a high mortality rate due to street accidents. In this connection the following figures are of interest :—

Passenger traffic, London.

Year.	Millions of passengers carried.			Journeys per head of population.		
	Tram.	Omnibus.	Total, including railways.	Tram.	Omnibus.	Total.
1904....	432	289	1,226	64	43	181
1910...	764	377	1,809	106	52	251
1914....	844	757	2,250	114	102	303
1919 ..	1,053	861	2,929	143	117	398
1923....	1,035	1,214	3,113	136	159	408

Mortality and the increased use of motor vehicles.

It is obvious that the death-rate arising from motor accidents has increased with the more common use of the motor vehicle, and it naturally occurs to one to enquire whether this high price must necessarily be paid in human lives in return for a speedier form of transport and locomotion. No doubt some of the risk of the motor vehicle arises from the fact that this speedier traffic is compelled to use narrow streets and ways designed in an age when road vehicles were fewer and slower. This can hardly be the whole explanation. Something must be charged to carelessness on the part of the driver, to negligence on the part of the victim, to mechanical defect of the machine, or to less obvious reasons. The motor vehicle is so easily controlled, in the mechanical sense, that this very virtue may become a fault by engendering over-confidence, resulting in carelessness on the part of the driver, who grows forgetful of the fact that the motor vehicle has weight in addition to propelling power, and therefore develops great momentum even at moderate speed. Finally, certain individuals lack the ability to judge the approaching speed of road vehicles, and these also contribute towards the production of a high accident rate.

Number of motor fatalities in relation to the number of motor vehicles.

It has sometimes been contended that the death-rate from motor accidents should be calculated, not upon the number of persons forming the population of a country, but upon the numbers of registered motor vehicles in that country. In the following table calculations have been made upon this basis:—

England and Wales.

Year.	Approximate licences issued in respect of motor vehicles.	Estimated deaths caused by motor vehicles.	Death-rate per 1,000 motor vehicles.
1906-1907	72,394	282	3.9
1907-1908	82,554	383	4.6
1908-1909	91,203	428	4.7
1909-1910	103,183	420	4.1
1910-1911	139,232	569	4.1
1911-1912	175,588	801	5.5
1912-1913	220,126	942	4.3
1913-1914	279,216	1,159	4.2
⋮	⋮	⋮	⋮
1919-1920	242,097	1,798	7.4
1920-1921	498,179	1,975	3.9

I must point out that these figures are *estimated* and *approximate*, but I believe them sufficiently accurate to indicate the relation existing between numbers of motor vehicles and numbers of deaths; the calculations resulting from the above figures have been made from available official returns. It will be observed that when results are measured in this manner, the risk of death due to motor accidents appears to be diminishing and not increasing. To reason thus is, however, a little dangerous; after all, the significant fact remains, that in 1923 mechanically propelled vehicles killed more than twice as many people as were killed by horse-drawn vehicles and motor vehicles together in 1904, and that, *because* of the increasing numbers of motor vehicles in use, the country loses each year a steadily increasing number of her citizens. The problem should be approached from the point of view of the actual numbers of deaths arising from this cause; the indisputable fact facing us is, that over 2,000 lives were lost by means of motor accidents in 1923, against 171 in 1904. For purposes of comparison I append the following figures relating to the County of London:—

Year.	Registered motor vehicles.	Deaths. Motor vehicles.	Rate per 1,000 motor vehicles.
1904	4,845	22	4.5
1905	4,651	36	7.7
1906	5,771	76	13.2
1907	6,421	124	19.3
1908	7,916	162	20.5
1909	8,707	168	19.3
1910	8,982	231	25.7
1911	11,667	291	24.9
1912	14,076	369	26.2
1913	17,862	424	23.7
1914	20,219	493	24.4
⋮	⋮	⋮	⋮
1919	37,390	575	15.7
1920	46,637	551	11.8

Later comparable figures than 1920* cannot be shown, owing to

* By the courtesy of the London County Council I have been supplied with detailed figures of the 1923 totals of motor vehicles licensed by that authority. These figures, which will appear in the forthcoming volume of *London Statistics*, indicate that motor-cars formed 36 per cent., commercial goods vehicles 22 per cent., motor cycles 22 per cent., and hackney motors 12 per cent. of the total number of vehicles licensed; in other words, these four types together provided 92 per cent. of the mechanically propelled and horse-drawn vehicles licensed by the authority.

the fact that, before 1921, commercial vehicles, although actually in existence, did not appear in the returns. (The figures, *including* commercial vehicles, appear on p. 429.) The only comparable rates available are formed by taking the numbers of mechanically propelled vehicles plying for hire in London, and licensed by the Commissioner of Police, and relating these to the numbers of deaths caused by such vehicles, namely, motor omnibuses, tramcars, and motor-cabs (taxicabs), as follows :—

London. Motor vehicles plying for public hire (omnibus, tram, motor-cab), and deaths by such vehicles.

Year.	Number of licensed motor vehicles.	Number of deaths.	Rate per 1,000 vehicles.
1904	843	6	7.1
1905	1,384	17	12.3
1906	2,275	37	16.3
1907	2,696	59	21.9
1908	5,941	96	16.2
1909	7,334	95	12.9
1910	10,008	137	13.7
1911	12,553	166	13.2
1912	13,727	234	17.0
1913	14,595	267	18.3
1914	13,136	243	18.5
⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮
1919	11,324	204	18.0
1920	12,130	145	11.9
1921	13,147	114	8.7
1922	13,773	120	8.7
1923	16,005	150	9.3

Motor fatalities in relation to class of motor vehicle.

It has been seen (*see* p. 407) that the death-rate due to accidents caused by mechanically propelled vehicles in 1923 was 14 times the rate arising from this cause in 1904. If this steadily increasing risk to life is to be reduced, the first requisite would appear to be a study of the numbers of deaths caused by each type of motor vehicle, and an endeavour made to discover the particular vehicle (or vehicles) in the main responsible for, and constituting, the principal menace to public safety. To this end the following table has been compiled for the period 1904–23.

Mortality rates per 1,000,000 living for each type of mechanically propelled vehicle.

Type of vehicle.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.
Tramcar	1.7	1.6	0.8	2.2	2.1	1.5	1.0	1.4
Motor-car ...	1.6	1.8	3.4	4.0	5.3	4.9	6.4	7.9
„ cab	—	—	—	0.2	0.3	1.0	1.4	2.6
„ bus	0.05	0.3	1.7	1.4	1.9	1.6	2.2	3.3
„ van	0.2	0.3	0.5	0.4	0.7	0.8	1.7	1.9
„ cycle	0.4	0.4	0.3	0.5	0.6	0.2	0.5	0.0
„ char-à-banc	—	—	—	—	0.02	—	—	—
„ vehicles (un- defined)	—	—	0.03	0.1	0.02	0.03	0.6	0.7
Steam wagon	—	0.05	0.1	0.02	0.1	0.2	0.1	0.5
„ roller	0.1	—	0.05	0.1	0.1	0.2	0.05	0.2
Traction engine	0.8	0.5	0.6	0.9	0.7	0.7	0.6	0.7

Type of vehicle.	1912.	1913.	1914.	1919.	1920.	1921.	1922.	1923.
Tramcar	1.0	1.2	1.4	0.9	1.5	1.5	2.0	2.1
Motor-car	10.3	12.8	14.2	17.4	18.6	18.3	19.7	21.7
„ cab	2.0	2.0	2.6	2.3	2.5	2.2	1.3	1.3
„ bus	5.3	6.2	5.4	4.6	3.4	3.5	4.3	5.7
„ van	2.2	3.7	5.5	11.8	13.5	13.2	14.4	14.7
„ cycle ...	1.8	2.8	3.4	4.6	7.1	6.0	5.6	7.7
„ char-à-banc	—	—	0.4	0.4	1.0	1.0	0.6	1.1
„ vehicles (un- defined)	0.7	0.7	0.8	1.8	1.0	1.0	1.0	1.1
Steam wagon	0.2	0.5	1.2	2.3	2.7	2.3	2.5	3.0
„ roller	—	—	—	—	—	0.1	—	0.2
Traction engine	0.7	1.2	0.9	0.6	0.5	—	—	—

It is obvious from these figures that motor cycles, motor-cars, and motor-vans claim the lion's share of motor fatalities. What, however, is not obvious is whether motor cycles, motor-cars, and motor-vans kill more of His Majesty's subjects for the same reason that white sheep eat more than black sheep, or whether they are more dangerous than in proportion to their numbers. Unfortunately our official data are not sufficiently detailed for the whole of the period under consideration to enable me to answer that question; the following figures are, however, relevant. Comparing 1922 and 1923 we have—

Type of vehicle.	Mortality increase, per cent.	Vehicle increase, per cent.
Motor-vans	2.2	14.0
„ cars	11.0	30.0
„ cycles	38.0	11.0

Note.—In the evidence submitted before the Select Committee on Motor Traffic, 1913, information relating to motor-traffic fatalities was tabulated, indicating type of vehicle, fast- and slow-moving, verdict of jury, etc., for the years 1910, 1911, 1912.

From the figures immediately above, it will be seen that the rate of mortality due to accidents caused by motor cycles greatly exceeded the rate of increase in the numbers of such vehicles ; on the other hand, the rate of increase in the numbers of motor-cars and motor vans exceeded the rate of mortality increase due to these vehicles.

General observations.

While it is gratifying to observe that the mortality experience arising from deaths caused by motor traffic in England and Wales is so much more favourable than is the case in the United States of America, and that fewer due to this cause occur in London than in New York, Chicago, etc., in proportion to the population of these cities, it is nevertheless impossible to ignore the fact that the loss of life is lamentably high.

Some drivers of motor vehicles appear to imagine that their responsibility towards the pedestrian begins and ends with the sounding of the motor-horn, and if, after such a warning has been given, a foot-passenger persists in passing in front of a vehicle and accident results, it is unfortunate, perhaps, but entirely the fault of the victim in not getting out of the way. It seems that such drivers are ignorant of the fact that the law is, on the contrary, on the side of the pedestrian, and it is the duty of the vehicle to avoid the foot-passenger. Sir William Byrne, of the Home Office, in his evidence before the Select Committee appointed to enquire into the circumstances which led to the large and increasing number of fatal accidents in the Metropolis due to power-driven vehicles, 1913, stated that, " The driver of a vehicle would not be entitled to run over a drunken man lying in Piccadilly, if he saw him and could avoid him, even though he had been grossly negligent in lying where he was." The pedestrian has, in fact, a clear right to the use of the road.

But even if this fact were universally recognized and acted upon, it might conceivably have little effect in reducing the mortality due to motor vehicles, so long as legislation affecting the licensing and control of such vehicles remains unaltered. Even the most competent and technically efficient driver—and among these I include drivers of motor omnibuses and taxicabs in the Metropolitan area, who have to satisfy the rigorous tests imposed by the Commissioner of Police in the Metropolis : such as these have no assurance that, in spite of their own proved skill, they will be free from accident due to the carelessness, thoughtlessness, or ignorance of ill-qualified drivers whom they may meet on the road ; on the contrary, the skilled driver may be, and indeed often is, through the exercise of his

own skill and care, involved in accident with, and through the unexpected actions of, the unskilled or amateur driver.

In the interests of public safety this should not be possible; each driver, whether owner-driver or servant, should *know* that, in the event of emergency, any other driver he may meet will react in a certain known manner conducive to safety. This condition is only attainable by requiring *every* driver of a motor vehicle to pass a driving test before the issue of a licence to drive. Such an examination would tend to remove some of the present road danger, but not all, for there remains the acquisition of "*road sense*," without which no driver is competent, but which can be acquired only by actual driving practice among traffic.

I am aware that this question has been considered by the Departmental Committee on the Taxation and Regulation of Road Vehicles. This Committee, whose members comprised some of the most eminent traffic authorities of the kingdom, after consideration of the advisability and practicability of imposing tests of mechanical knowledge and driving capability, announced their decision in their Second Interim Report in the following words :—

"From the evidence which has been submitted, it would appear that there is insufficient justification for, or consequent advantage in, requiring applicants to undergo any test of mechanical knowledge or driving ability. As pointed out by the Royal Commission and in the Shortt Report, there are practical difficulties in requiring such a test; one is, that a man cannot be trained efficiently except by actual experience of driving, and this must be largely acquired on the roads; another, that it would involve the setting up of some examining authority or officials, as the tests could not well be carried out by the Licensing Authorities, who would presumably be the County and Borough Councils; further, it would necessitate heavy expense. No evidence has been tendered which would indicate that accidents caused by motor vehicles are to any considerable extent due to technical incompetence on the part of the drivers as distinct from lack of experience, and there is little doubt that accidents are not infrequently associated with undue confidence or occasional recklessness on the part of skilled drivers."

In the absence of any detailed analysis of the circumstances attending accidents caused by motor vehicles, I am unable to express any opinion on the views of the Committee respecting the relation between accidents and technical incompetence. "Actual experience of driving," to which they refer, I have already discussed, remarking

above. "there remains the acquisition of 'road sense,' without which no driver is competent."

In view of the expressed opinion of the Departmental Committee quoted above, that "*there is little doubt that accidents are not infrequently associated with undue confidence or occasional recklessness on the part of skilled drivers,*" it is interesting to note that in 1912 the Home Office issued a circular to magistrates calling attention to the fact that offenders against the law in this respect are occasionally treated too leniently, and pointing out that, under the head of "Serious Offences" came such offences as driving recklessly, negligently, etc. Sir William Byrne, in his evidence before the Select Committee appointed to enquire into the circumstances which led to the large and increasing number of fatal accidents in the Metropolis due to power-driven vehicles, 1913, stated, "We at the Home Office have now and then cases coming to our knowledge which have been dealt with very leniently . . . a person has been fined for reckless driving when, in our opinion, and in the opinion of the Director of Public Prosecutions whom we have consulted, he ought to have been prosecuted for manslaughter and got a very severe sentence." Before the same Committee, the firm of solicitors acting as official legal advisers to the Commissioner of Police declared, "that it is no defence to an indictment for manslaughter, when the death is shown to have been caused in part by the negligence of the accused, that the deceased was also guilty of negligence, and so contributed to his own death." In the face of these opinions, the responsibility of motor drivers is clear.

Again, and in addition to the negligence or inefficiency of the driver, another contributory cause is of importance, namely, that of mechanical soundness of the machine. The risk arising from the unknown presence of a defective part or parts in the construction of the vehicle increases, especially since such large numbers of motor vehicles of all types change hands at second-hand prices; in fact, the demand for such vehicles has produced an entirely separate branch of salesmanship in the motor trade. It is, I am given to understand, practically impossible, in the case of the second-hand car, to discover certain weak spots or defective parts without scraping away paint, a procedure to which the seller would have the very strongest objections. This is not a matter of such great importance or significance where the private car is concerned, but it may present the gravest problems, and give rise to serious risks, when second-hand cars or chassis designed for one purpose are purchased and converted into vehicles plying for public hire, such as pleasure charrs-à-bancs, etc., for in such case, where construction is subjected to stresses

and strains beyond the limits prescribed in the original design, the lives of passengers are at stake.

There would appear the very strongest grounds for insisting that *each* motor vehicle, whether used for private or commercial purposes, should be required by law to be insured against mechanical defects, for this would provide the authorities and the public with an additional safeguard.

In this connection the views of the Departmental Committee on the Taxation and Regulation of Road Vehicles, contained in their Second Interim Report, 1922, must be considered :—

“ The Committee have considered the suggestion that all vehicles should be examined and tested regularly by officers of Local Authorities, or by the police, but they have come to the conclusion that the work involved and the heavy expense entailed render such a proposition impracticable, at any rate at the present time. There would, however, seem to be no reason why the police should not be empowered, as distinguished from required, to examine the braking equipment on all vehicles, and the Committee consider that the existence of such a power would tend towards the maintenance of brakes at a higher standard of efficiency. They accordingly recommend that such powers should be conferred upon police officers in uniform or holding proper authority.”

Speaking as a layman, with practically no technical knowledge, such a recommendation appears a little weak, for I cannot understand how any police official (except one possessing considerable mechanical knowledge and experience of motor vehicles) can possibly express any opinion of value on such a point. What can be the use of “ powers ” in the absence of expert knowledge ? On the grounds of expense, the Committee are certainly on thicker ice ; but is it necessary that Local Authorities should shoulder this expense ? If the law demanded compulsory insurance of motor vehicles, the risk of big financial loss which would face insurance companies issuing such policies would compel them to demand that all proposals for insurance were acceptable only after inspection of the vehicle by their own inspector. The issue of a licence by the Local Authority would then be contingent upon the presentation of a certificate of mechanical efficiency—in other words, the insurance policy covering the vehicle.

It will be objected that the cost of compulsory insurance would prove an expensive addition to the present cost of maintenance of a car. I suggest, however, that because of the large and competitive business in insurance which would necessarily follow the introduction of such a measure, insurance companies would be able to quote

exceedingly low and attractive rates, making the additional cost of motoring negligible. Further, since manufacturers of motor vehicles frequently provide purchasers with a free insurance policy, together with a guarantee of mechanical efficiency, covering the first year of service of the vehicle, the proposal I make would appear to present no insuperable difficulty; after all, the insurance and guarantee service provided by manufacturers are *paid for by the purchaser* in the price of the car—there is little that is “free” about this service, but it passes unnoticed by the buying public.

It will have been observed, from what has already been said, that in the registration of motor vehicles, the question of technical skill and efficiency and the physical fitness of drivers is never raised, except in London. Manufacturers or motor sales agencies frequently advertise the fact that all purchasers of cars are entitled to “free instruction in driving.” Despite the fact that such “instruction” can obviously be only of the most elementary kind, the new owner-driver can, and does, accept delivery of his new purchase after such “instruction,” and drives away to the danger of the general public. Lacking every attribute necessary to the competent handling of a car, he continues, for a time, a menace along every road he uses. Even worse, perhaps, is the condition under which a commercial motor vehicle may be operated. The porter of to-day, after having been shown how to start and stop the machine, may conceivably become the motor-van driver of to-morrow. Whether commercial van drivers are less competent and efficient than other types can only be established after a very much more careful investigation than I have been able to make. In neither of these instances is there the slightest effort made, officially, to measure the degree of skill or the physical suitability of such drivers, nor has any Local Authority power to demand a standard of efficiency before issuing licences to drive to applicants. I have already referred to the views expressed by the Departmental Committee on Taxation and Regulation of Road Vehicles in so far as driving capability is concerned; briefly summarized, their opinion regarding tests of physical fitness of drivers are as follows:—

“Accidents due to physical incapacity of the driver are, in the opinion of the Committee, comparatively rare, and difficulties of imposing a test almost insuperable;

“Heavy expense entailed;

“Difficulty of fixing a standard of fitness;

“Difficulty of deciding frequency of examination.”

The Committee were, however, of the opinion that “no person should drive a mechanically propelled vehicle unless he is fit to do

so. They recommend that every applicant for a driving licence should be required to make a declaration in the following terms :—

“ I hereby declare that, to the best of my knowledge, I am not suffering from any disease or physical disability which would be likely to cause the driving of a mechanically propelled vehicle by me to be a source of danger to the public.”

It will be seen this proposal leaves the declaration to the conscience of the individual applicant ; of course, in the event of accident arising proved to be due to physical disability, such a fact would be considered by any judicial authority. I cannot help but feel, however, that with the introduction of measures suggested, nothing but good could result, and “ difficulties ” and bogies of “ expense ” would disappear were the problem faced resolutely. Consider how conditions have improved in London, where drivers have to satisfy the Commissioner of Police that they are physically fit, technically efficient, possess skill in street driving, while the vehicle itself must conform to specifications laid down by the same authority.

The teaching of caution is admirable, and the “ Safety First ” cry undoubtedly plays an important part in controlling and reducing, to some extent, the numbers of accidents due to motor traffic. There are, however, thousands of individuals using the streets and roads utterly incapable of judging the speed of approaching vehicles ; others become confused and helpless in traffic ; children are over-daring when crossing thoroughfares ; the old and infirm lack the sight, or suffer other disabilities, which render them incapable of complete personal control. The preaching of caution to such as these is obviously insufficient, and the responsibility, therefore, will largely rest upon the drivers of motor vehicles.

I am aware that there are many questions which remain to be discussed in an enquiry of this kind but which I have not found time to investigate. I have referred very briefly to the expectation of motor drivers, that pedestrians will be able to get out of the way of their approaching vehicles ; failure in the realization of this expectation is the factor which results in injury or death. Other important matters which remain to be considered are questions of speed, time of day when accidents appear more likely to occur, variety of traffic, congestion, and the introduction of “ one-way ” traffic in certain areas.

For instance, it would be interesting and valuable to discover within what speed-limits the majority of accidents and fatalities occur ; at what hour during the day the highest number of fatalities caused by motor vehicles arise, and whether these are more frequent

in mixed traffic, or in traffic that is, in the main, composed of mechanically propelled vehicles.

Here I should like to call attention to a fact arising out of this enquiry, and not without interest. It is this: In congested traffic areas, the risk from accident or death due to motor vehicles appears to be considerably less than is the case in areas not so burdened with traffic—the congestion produces a slowing-up of all vehicles in both directions, and so allows the reckless or thoughtless driver no opportunity of breaking any rule of the road; in addition, perhaps, such congestion causes the pedestrian to exercise greater caution when stepping off a pavement or in crossing a thoroughfare. This latter contention is, I think, within the experience of us all. Speaking of London traffic, I know that, personally, I am conscious of less risk in crossing the road at, say, the Mansion House corner, where there is an immense volume of traffic at all hours, than I am when crossing such a thoroughfare as Whitehall. In the one case the traffic is dense, but slow-moving; in the other, less crowded, but much more rapid. In the absence of other controlling factors, then, congestion due to traffic to some extent provides its own remedy as a means of reducing mortality arising from street accidents.

Recommendations.

The investigation suggests that, if the safety of foot-passengers is to be ensured, it is necessary to introduce :—

- (1) A change in the law to permit (and insist upon) Local Authorities to establish examinations of all drivers regarding physical fitness, technical skill and driving capability, before the issue of a licence to drive.
- (2) Compulsory insurance of the vehicle against mechanical defect (including third-party risk).

Conclusion.

In concluding this paper, I desire to express my sincere thanks for, and appreciation of, the generous help so readily accorded by the Ministry of Transport in supplying me with abundant data relating to this subject.

The Ministry of Transport undertakes the investigation of road accidents, and the results of these investigations appear in the

“Report on the Administration of the Road Fund.” The causes of such accidents are classified as follows :—

- (a) *Error or negligence on the part of the driver or drivers*—distinguishing between negligence, faulty judgment, inexperience, loss of control, etc.
- (b) *Error or negligence on the part of all persons*—*e.g.* pedestrian at fault, horse-drawn vehicle at fault, etc.
- (c) *Mechanical defects or unsatisfactory road conditions*—indicating whether due to defective steering gear or other mechanical defect, bad road surface, dangerous corner, etc.

Such data are tabulated for five types of motor vehicle, indicate number of accidents investigated and number of persons killed and injured. These data, however, excellent though they are, refer only to a very small proportion of the number of persons killed by motor vehicles, *e.g.* in 1924 relating to 138 deaths, in 1925 to 166 deaths.

APPENDICES.

*Number of licences issued in respect of motor-cars.
England and Wales.*

Year.	Motor-cars.	Hackney motors.	Total.
1904	—	—	—
1905	—	—	—
1906	61,774	10,620	72,394
1907	69,784	12,770	82,554
1908	73,995	15,208	91,203
1909	81,199	21,984	103,183
1910-1911	110,314	28,918	139,232
1912	144,328	31,260	175,588
1913	185,914	34,212	220,126
1914	233,094	46,122	279,216
⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮
1919	203,478	38,619	242,097
1920	432,285	65,894	498,179

Under the provisions of the Finance Act, 1920, and the Roads Act, 1920, an entirely new system of motor taxation was introduced in 1921, in which year, for the first time, commercial motor vehicles were brought under a motor-vehicle tax. The following figures have reference to the numbers of licensed motor vehicles on November 30 in each year:—

Year.	Motor cars.	Hackney motors	Commercial motor vehicles.	Motor cycles.	Miscellaneous	Total.
1921	250,000	76,000	135,030	355,000	57,665	873,665
1922	293,740	72,263	158,856	352,340	56,109	933,308
1923	382,538	78,358	181,235	391,087	60,093	1,093,311

Deaths due to accident by vehicles mechanically propelled. England and Wales.

	1900. Population, 32,249,187.	1901. Population, 32,912,922.	1902. Population, 32,950,906.	1903. Population, 33,203,321.	1904. Population, 33,680,287.	1905. Population, 33,988,811.	1906. Population, 34,312,040.	1907. Population, 34,688,906.	1908. Population, 35,059,481.	1909. Population, 35,423,806.
Electric tram ...	8	35	57	63	55	53	29	78	74	54
Steam tram "	2	2	8	1	2	3	—	—	—	—
Motor-car "	4	6	15	37	56	60	118	153	187	173
" cab	—	—	—	—	—	—	—	8	12	36
" omnibus	—	—	—	—	2	11	59	48	65	55
" van "	—	—	—	—	7	10	20	16	26	30
" cycle "	—	5	4	13	16	15	12	20	21	8
" collisions	—	—	—	—	—	—	—	—	—	—
" chais-à-bancs	—	—	—	—	—	—	—	—	1	—
" vehicles (unde- fined)	—	—	—	—	—	—	1	4	1	1
Steam wagon, &c.	—	—	—	—	—	2	4	1	5	7
" roller "	—	2	3	4	5	—	2	5	5	6
Traction engine	16	24	16	18	28	18	20	32	21	25
Motor wagon ...	—	—	—	1	—	—	—	—	—	—
Total ...	30	74	103	137	171	172	265	365	421	395
<i>Deaths, 5-10 years.</i>										
Electric tram ...	—	3	8	8	—	—	—	—	—	—
Steam tram "	—	1	2	—	13	5	—	—	—	—
Motor-car ...	—	2	3	3	—	2	21	36	39	21
" van "	—	—	—	—	1	2	6	3	7	14
" omnibus	—	—	—	—	—	—	6	4	8	11
" cab "	—	—	—	—	—	—	—	—	1	—
" cycle "	—	—	—	—	—	—	—	—	1	—
" chais-à-bancs...	—	—	—	—	—	—	—	—	—	—
Total, 5-10 years	—	6	13	11	14	7	33	43	56	16

Deaths due to accident by vehicles mechanically propelled. England and Wales—Contd.

	1910. Population, 35,791,002.	1911. Population, 36,189,085.	1912. Population, 36,482,156.	1913. Population, 36,600,220.	1914. Population, 36,660,684.	1919. Population, 36,500,000.	1920. Population, 37,021,000.	1921. Population, 37,886,242.	1922. Population, 38,158,000.	1923. Population, 38,107,000.
Electric tram.	38	52	39	41	52	32	55	55	77	80
Steam tram . .	—	—	377	455	524	—	—	—	—	—
Motor-car . . .	228	286	377	455	524	639	698	695	751	831
" cab . . .	51	95	74	73	96	83	92	85	51	50
" omnibus . .	77	121	102	220	201	168	128	133	166	219
" van . . .	61	69	81	132	204	435	508	499	551	563
" cycle . . .	19	31	66	101	126	170	266	226	214	296
" collisions . .	—	—	—	—	—	—	—	130	118	162
" chairs-&-banes . .	—	—	—	—	14	13	39	38	23	41
" vehicles (unde- fined) . . .	21	28	25	21	31	66	39	36	39	41
Steam wagon, &c. .	4	20	7	17	41	83	103	87	96	117
" roller . . .	2	8	—	—	—	—	—	5	1	8
Traction engine . .	23	25	27	41	33	22	20	—	—	—
Motor wagon....	—	—	—	—	—	—	—	—	—	—
Total . . .	524	735	888	1,104	1,325	1,711	1,948	1,989	2,087	2,414
<i>Deaths, 5—10 years.</i>										
Electric tram	—	—	—	—	—	—	—	—	—	—
Steam tram . .	—	—	—	—	—	—	—	—	—	—
Motor-car . . .	54	75	91	116	123	138	173	180	175	164
" van . . .	9	21	23	25	38	93	120	106	125	128
" omnibus . .	14	24	28	41	39	47	20	21	25	29
" cab . . .	3	21	8	8	7	19	12	14	6	5
" cycle . . .	—	—	—	—	—	—	—	9	5	4
" chairs-&-banes . .	—	—	—	—	3	2	6	5	6	9
Total, 5—10 years	80	141	150	190	210	299	331	335	342	339

*Deaths caused by mechanically propelled vehicles.
London Metropolitan Police area.*

Year.	Motor omnibus.	Tram-car.	Motor-cab.	Motor-car.	Motor-van, &c.	Motor cycle	Traction engine.	Total.
1900	—	—	—	—	—	—	—	—
1901	1	1	—	1	—	—	—	3
1902	—	5	—	1	—	—	—	6
1903	—	2	—	4	—	—	—	6
1904	2	4	—	16	—	—	—	22
1905	3	14	—	15	4	—	—	36
1906	25	12	—	26	8	3	2	76
1907	35	22	2	52	8	4	1	124
1908	62	26	8	47	14	2	3	162
1909	52	26	17	52	17	1	3	168
1910	62	41	34	59	34	—	1	231
1911	100	32	34	87	33	5	—	291
1912	167	37	40	75	43	7	—	369
1913	180	58	29	83	60	13	1	424
1914	148	37	58	118	107	22	3	493
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1919	136	42	26	138	203	25	5	575
1920	80	39	26	166	207	32	1	551
1921	54	30	30	129	199	46	2	490
1922	60	35	25	176	259	39	1	595
1923	101	25	24	184	221	39	—	594

Motor vehicles registered and licensed by the London County Council.

Year.	Motor-cars.	Heavy motor-cars.	Motor cycles.	Total.
1904	2,993	—	1,852	4,845
1905	2,758	—	1,893	4,651
1906	3,408	616	1,747	5,771
1907	4,201	760	1,460	6,421
1908	5,770	484	1,362	7,916
1909	6,994	202	1,511	8,707
1910	6,961	117	1,904	8,982
1911	8,567	404	2,696	11,667
1912	8,955	1,280	3,841	14,076
1913	10,463	1,885	5,514	17,862
1914	12,164	622	7,433	20,219
⋮	⋮	⋮	⋮	⋮
1919	16,417	6,423	15,090	37,930
1920	24,424	4,576	17,637	46,637
1921	131,541*			131,541
1922	166,329			166,329
1923	198,979			198,979

* Prior to the year 1921 commercial vehicles were not licensed.

Licences to drive (mechanical power) issued by the London County Council.

Year.	Total.	Year.	Total.
1904	8,070	1913	53,417
1905	11,341	1914	65,558
1906	16,759	.....	.....
1907	20,025	.....	.....
1908	22,885	1919	96,241
1909	27,535	1920	99,600
1910	32,171	1921	107,679
1911	37,409	1922	116,426
1912	43,997	1923	134,371

Metropolitan area.

Year.	Licensed vehicles (mechanically propelled).				Driving licences. Mechanical power.
	Motor omnibus.	Tramcar.	Motor-cab.	Total.	
1904 ..	31	810	2	843	1,800
1905 ..	241	1,124	19	1,384	2,497
1906 ..	783	1,396	96	2,275	4,272
1907 ..	1,205	1,768	723	2,696	5,534
1908 ..	1,133	2,003	2,805	5,941	7,363
1909	1,180	2,108	3,956	7,334	10,084
1910 ..	1,200	2,411	6,397	10,008	12,663
1911	1,962	2,665	7,626	12,553	16,146
1912 ..	2,908	2,859	7,969	13,727	18,390
1913 ...	3,522	2,786	8,287	14,595	20,191
1914 ...	3,057	2,819	7,260	13,136	20,768
...
...
1919	3,314	2,619	5,391	11,324	22,940
1920	3,365	2,740	6,025	12,130	22,608
1921	3,890	2,794	6,463	13,147	22,077
1922	3,787	2,795	7,191	13,773	23,784
1923	5,117	3,214	7,674	16,005	26,464

*Motor vehicles plying for public hire in the Metropolitan area, and
licensed by the Commissioner of Police.*

Year.	Mortality rates per 1,000 vehicles for			
	All three types.	Tramcar.	Motor omnibus.	Motor-cab.
1904	7.1	4.9	64.5	—
1905	12.3	12.5	12.5	—
1906	16.3	8.6	31.9	—
1907	21.9	12.4	29.0	2.8
1908	16.2	12.9	54.7	2.9
1909	12.9	11.3	44.1	4.3
1910	13.7	17.0	51.7	5.3
1911	13.2	12.0	51.0	4.5
1912	17.0	12.9	57.4	5.0
1913	18.3	20.8	51.1	3.5
1914	18.5	13.1	48.4	7.9
⋮	⋮	⋮	⋮	⋮
1919	18.0	16.0	41.0	4.8
1920	11.9	14.2	23.8	4.3
1921	8.7	10.8	13.9	4.6
1922	7.5	12.5	15.8	3.5
1923	9.4	7.8	19.7	3.1

*Motor vehicular traffic at various points in London between 8 a.m.
and 8 p.m.*

Year.	Hyde Park Corner.	Trafalgar Square.	Piccadilly Circus.	Marble Arch.
1904	15,362	15,661	11,030	22,471
1923	45,579	35,324	34,537	29,585

Note.—These figures exclude motor cycles.

*Motor vehicle registrations in the registration area of the United States
of America.*

Year.	Total.	Year.	Total.
1904	57,864	1913	1,258,062
1905	77,988	1914	1,711,339
1906	106,928	⋮	⋮
1907	142,061	⋮	⋮
1908	197,479	1919	7,565,446
1909	311,197	1920	9,231,941
1910	468,497	1921	10,465,995
1911	639,514	1922	12,238,375
1912	944,000	1923	15,092,177

*Deaths caused by motor vehicles in the registration area of the
United States.*

Year.	Total deaths.		Rate per 100,000.		Mortality rate, all causes (per 1,000).
	Motors.	Street cars.	Motors.	Street cars.	
1904	Deaths caused by injuries by vehicles include horse-drawn.				
1905					
1906	183	1,488	0.4	3.6	15.7
1907	294	1,880	0.7	4.5	16.0
1908	393	1,696	0.9	3.8	14.8
1909	632	1,723	1.2	3.4	14.4
1910	980	1,949	1.8	3.6	15.0
1911	1,291	1,883	2.2	3.2	14.2
1912	1,758	1,832	2.9	3.0	13.9
1913	2,488	1,998	2.5	3.2	14.1
1914	2,826	1,673	4.3	2.5	13.5
⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮
1919	7,968	1,916	9.4	2.2	12.8
1920	9,103	1,746	10.4	2.0	13.0
1921	10,168	1,460	11.5	1.6	11.6
1922	11,666	1,491	12.5	1.6	11.8

Note.—Deaths due to motor-cycle accidents are *not* included. The figures are incomplete; in some areas motor cycles, dealers' and manufacturers' licences not included; some States give estimated figures; State- and city-owned motor vehicles are not registrable.

*Deaths caused by motor vehicles in American cities.
Rates per 100,000 living.*

Year.	Chicago.		New York City.		Boston.		Los Angeles.	
	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.	Deaths.	Rate.
1907	27	13.2	42	9.6	—	—	—	—
1908	23	11.0	84	18.7	—	—	—	—
1909	23	10.8	90	19.4	—	—	—	—
1910	52	23.8	111	23.3	—	—	—	—
1911	62	27.8	128	26.1	—	—	—	—
1912	104	45.6	188	37.4	—	—	—	—
1913	291	22.4	643	22.8	—	—	—	—
1914	—	—	310	5.5	—	—	—	—
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1919	328	12.3	780	14.0	125	16.8	119	21.1
1920	472	17.3	773	13.6	89	11.8	142	24.1
1921	569	20.5	885	15.4	103	13.6	165	27.1
1922	623	22.0	896	15.3	129	16.9	187	29.5

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DISCUSSION ON MAJOR EDGE'S PAPER.

SIR EDGAR HARPER : Mr. President, Ladies, and Gentlemen. It is with much pleasure that I rise to propose a hearty vote of thanks to Major Granville Edge for the paper which we all know must have caused him a great deal of labour and research, and for the multitude of figures that he has assembled for our consideration.

The paper is full of suggestive points, and our difficulty, I fear, will be to confine our discussion within the limits which Major Edge has laid down for himself. That being so, I do not propose to occupy the full time that is ordinarily allowed to the proposer of the vote. We have a number of visitors present to-night. Unfortunately, Sir Henry Maybury, the Chairman of the Advisory Committee on London Traffic, is unable to be present, but we have with us Mr. Rees Jeffreys, the Chairman of the Road Association.

I have a few remarks to make on the paper on points that struck me as I read it through. The first thing is the peculiar nature of the comparison between cancer mortality and motor-traffic mortality. It does not seem to me possible to compare the two things reasonably. Cancer mortality has been with us for many generations; motor traffic mortality has been with us for this generation only, and naturally the motor-traffic mortality has increased to a much greater

extent during this generation, and one is not at all surprised that the growth of motor fatal accidents is so much greater in the ratio used by Major Edge than the increase in the deaths from cancer. Surely the way in which to measure—if a comparison is to be made—is to take the number of deaths per 1,000 vehicles, rather than per 100,000 living. If that is done, as Major Edge has shown in his table on p. 414, the percentage of fatal accidents due to motor vehicles for 1921 is exactly the same as in 1906-7. Therefore one is not alarmed by the comparison with cancer.

The figures as a whole show that the increase in the deaths from motor traffic is due almost entirely to the growth in the number of vehicles, and certainly not to any increase of carelessness on the part of the motor driver—not that I would for a moment attempt to discourage any attempt to improve the high qualities that most of our motor drivers possess. It would be extremely interesting to have the same percentage of deaths per 100 or 1,000 vehicles in that very valuable table of the deaths of children, because I should hope to find that the proportion of deaths of children from that cause is actually decreasing.

I venture to suggest to Major Edge that the information he gives us at the bottom of p. 412 would be very much greater if, instead of confining himself to an increase in percentages (an increase at one particular point of traffic which is not named), he could have given us the actual figures on which the percentage is based.

Again, on p. 413, there is an interesting table from the report of the Commissioner of Police, in which the expression "total traffic" is used, and I find difficulty in appreciating what is meant by that phrase, because it is impossible for anyone to know what the total traffic in the streets of Greater London is on any particular day or hour. I assume—and shall be glad to hear if I am correct—that it really means the aggregate traffic enumerated at certain points on a given day. It might be as well to make that clear.

On p. 415 the table refers not to the County of London, nor to the Police area, but to Greater London; that is to say, the City of London plus the Metropolitan Police area.

There is a particular reason for deploring the absence of Sir Henry Maybury, because the figures given in that particular table would be of special interest to him, if he has not already seen them. He has a proposal actually before the public and the omnibus proprietors for the reduction of the number of omnibuses using the streets; and that is a matter which has a direct bearing upon the subject of this paper, because it is clear from the statistics that the motor omnibus is a much greater destroyer of life in the streets of London than the tramcar, and the proposal to reduce the number of motor omnibuses undoubtedly would improve the safety of the streets, and also spread the traffic, as it should be, between other methods of locomotion. The motor omnibuses have the roads

provided for them by the ratepayers, free. The tramways have to lay their own track, and the railways have to buy the land and lay the track as well, and no fair competition can exist between these three unless there is control. It is to be hoped that the suggestion put forward by Lord Ashfield for the pooling of these London traffic undertakings, which would result in great benefit to the travelling public, will be carried out at the earliest possible moment.

I was very much interested in the reference to the motor driver sounding his horn. I have so often seen aged and infirm people made to jump by the thoughtless motorist sounding his horn, forgetting that the pedestrian has the first right to the use of the road. In these days we are in great danger of filching from the pedestrian the undoubted right which he possesses under the law. The education of motor drivers in this respect is certainly one that should be taken care of, and it might have the effect of reducing accidents on the street.

There is one way in which motor traffic will itself reduce accidents. The accidents that have been recorded during the last twenty years are due in a large degree to the fact that fast- and slow-moving traffic is so mixed in the crowded streets of London, and it is quite impossible for the average pedestrian to gauge the pace at which each is coming. When he thinks the road is clear behind a slow-moving vehicle, he suddenly finds a fast vehicle coming along behind, and that is the cause of a great many accidents. When the time comes for horse-drawn vehicles to be withdrawn from our principal thoroughfares, I look forward to a considerable drop in the number of road accidents due to motor vehicles in the streets of London.

I feel sure we shall all agree in giving a hearty vote of thanks to Major Edge for his most interesting and valuable paper.

MR. D. R. WILSON: Mr. President, Ladies, and Gentlemen. I have much pleasure in seconding the vote of thanks to Major Edge for the extremely interesting paper to which we have all listened. Unlike the proposer of the vote of thanks, I am an ignoramus on this subject, and my comments must consist largely of questions on which I should be glad to be enlightened.

One thing that strikes me in the paper is the fact that on pp. 406-11 Major Edge has taken the period 1904-23 as the range over which the increase is set forth. I notice in two or three of the tables that the figures for 1904-5 are very small, and then there is an abrupt rise at 1906, after which the increase is much slower. That is particularly noticeable in the table on p. 409. By taking 1904, with its small figures, as the starting-point, Major Edge certainly has the chance of making our flesh creep and of talking of increases of 3,000 per cent., but I should have thought that it would have been fairer to select as the basis of comparison some

subsequent year, say, 1906, when the motor-car was beginning to become a vehicle instead of a toy.

In many respects, however, the mortality rate *per se* is less important than the mortality rate per 100 or 1,000 vehicles, and I should like to comment on two tables that appear on pp. 414-15, which give the death-rate per 1,000.

The first one, which apparently refers to the whole country, gives a death-rate varying from 3.9 to 7.4, and during the pre-war years it was not very far away from being constant. When we turn to the next table, which deals with the County of London, we see that, unlike the previous table, there is an almost continuous increase up to 1910. The trend shown by the two tables is in fact quite different, and I wonder if Major Edge can offer any explanation why London should be so different from the country as a whole. Incidentally, the data in the London tables show that in 1912 there were no less than 26.2 deaths for every 1,000 motor vehicles. In other words, in that year in London 1 motor in every 40 killed a person. This seems to me almost incredible, and I would invite an explanation from Major Edge.

It is consoling to my mind to see that there is a tendency—from the tables on pp. 415-16 and others—for the death-rate per 1,000 motor vehicles to decrease during the last two years quoted. Whether it is due to the increased realization on the part of the public to the danger of motors, or to more careful driving on the part of motor drivers, it seems to me an encouraging fact, though it is minimized to some extent by Major Edge.

As to the general part of the paper, I am very glad to see that Major Edge puts forward at the end some proposals for further investigation. There is one point in particular that I suggest might be very important, and that is the question of determining the time of day at which the accident happened, with a view to finding out the relative incidence of accidents during light and darkness. In this connection I cannot help feeling that a simultaneous enquiry in this country and in the United States on parallel lines might yield some interesting information. Let me illustrate what I have in mind. In the United States there are no bicycles. When I was there in 1924 for three months I only saw two, and they were pointed out as curiosities, just as a bone-shaker would be in England. Supposing, now, we wanted to find out whether the allegation so often made that the cyclist is a most important factor in accidents by night is true, we could of course determine this directly by finding the number of cyclists killed and comparing that number with the total deaths. It would, however, be possible to test the truth of the allegation by a simple comparison between the accident rates in America by night and the accident rates here by night. If the allegation that cyclists contribute largely to night accidents is true, we ought to find the accident rate by night is higher in England—where there are many cyclists—than in America, where there are none.

Major Edge makes various suggestions and recommendations.

I speak with all diffidence, but I should have thought that the Committee, which recommended that tests for driving should not be applied, was right, for I cannot help feeling from my own experience that the beginner is not a careless person. In my own case I was punctiliously careful when I first started, and I am sure if any serious accident had happened it would not have been my fault. On the other hand, I began to learn rather late in life, and that brings me to the question of age. The Industrial Fatigue Research Board has just published a statistical report by Miss Newbold, which indicates that the incidence of industrial accidents is closely associated with the age of the person incurred, the natural explanation being that there is a sort of bravado in youth which makes them more indifferent to the consequences of dangerous practices. I forget what the lower limit for motor licences is, but I believe it is seventeen. It seems, therefore, worth while enquiring into the age of the motorists having accidents. If a high proportion of young drivers were found to be involved, accidents, I suggest, might be reduced to some extent if the lower age limit for licences was put up several years.

These are the main points I have to put forward, but there is one other small one on which I should like to be enlightened. These mortalities include, I presume, not only pedestrians, but also any accident to the motor driver himself or the passengers in the car.

I have much pleasure in seconding the vote of thanks to Major Edge.

Mr. W. REES JEFFREYS thought the Society was to be congratulated upon bringing this question forward as a subject for discussion. He joined with the mover and seconder of the vote of thanks in thanking Major Edge for having collected the statistics and for preparing the paper. Anything that tended to make traffic conditions safer was to be sought for, and, when found, should be employed.

He would not follow the preceding speakers in the analysis of the figures which Major Edge had collected, but would go at once to his recommendations. Unfortunately, he did not agree with these recommendations. His criticism of Major Edge's valuable paper was that the statistics and facts did not support his recommendations.

He spoke with some little knowledge of this question, as he was a member of the Departmental Committee whose report Major Edge had quoted. A great deal of evidence was taken on the question of examination of drivers before granting a licence, and in the end it was unanimously resolved not to make a recommendation of the kind Major Edge had put forward. The examination of drivers was one of those obvious proposals which will not stand investigation.

It was impossible in a few minutes to summarize the case against examinations for drivers. First of all, the recommendation was

based upon a fallacy. It assumed that knowledge and skill were the governing factors; they were not. The governing factors were judgment and consideration for others, and these could not be tested by examination. He had himself driven motor-cars for a quarter of a century, and had sat by the side of innumerable drivers. Speaking from his own experience as well as from that of others, he knew men who would pass any examination in the matter of skill and knowledge of motor-cars, but he would not drive with them if he could help it. They had all the skill possible, but they had not any consideration for others, and they had not judgment. This could only be found out by experience, not by examination.

He knew something about the insurance of motor-cars. The first year's risk on a motor-car was a bad risk for the insurance company, but the novice did not cause serious accidents. It was the more experienced driver who took risks. Therefore general experience did not support the proposition that by examination the good and bad drivers could be found out.

There were other objections. First of all, such examination would impose a tax of time and money upon all people who desired to drive. It would tend to drive out the owner-driver—a desirable class.

Major Edge wanted to give this power of examination to every County Council and Borough. That would mean the setting up of officials in every county to examine, and it was not desirable to increase that type of bureaucracy. He (the speaker) had seen the system at work on the Continent, and anyone who knew anything about it knew that it became somewhat of a farce. It was quite easy for certain persons to get their certificates to drive without any trouble by means of a little baksheesh, while other people who might not be friends with the licensing authorities did not get their certificates to drive. The small official with power over others was a dangerous type, and the multiplication of that type should not be encouraged. Again, if the power were entrusted to Local Authorities, he was very doubtful as to its success. He did not like to trust Local Authorities with power to regulate other people.

He had mentioned five objections to this system of examination, but it fell on the first, because by examination it was impossible to test judgment and consideration for others.

He did not want to stop at criticism of this recommendation; he would like to be constructive as well. Something must be done to reduce the number of road accidents, particularly of fatal accidents. The number of motor-cars on the road would be doubled in a few years' time. This was shown by the experience of the United States. The proportion of motor-cars to population in the United States was 1 in 6, and this number was to be increased. The demand for motor-cars was such in America that people were prepared to go short in clothes, food, and rent in order to have a motor-car. The same sort of thing was being seen in various centres

in England. Motor-cars were on the increase. How was the traffic problem to be dealt with?

His experience showed that the number of drivers who lacked judgment and consideration for others to a degree that made it dangerous for them to be allowed to drive, was a small percentage of the entire number of motor drivers. It was only possible to guess, but he would not put it higher than 5 per cent., but that 5 per cent. could be very dangerous. An average motor-car driver travelled 6,000 miles a year, and in that distance he could kill a good many people if entirely reckless. The real problem was how to discover that 5 per cent. and eliminate them. That was the practical problem, and it would not be solved by examination.

Curiously enough, the means had existed all along by which reckless drivers could be eliminated if the authorities of the country had put the law into practice. Parliament, in the original Motor-car Act, legislated better than it knew. It gave a licence, and gave it on condition that it was held during good conduct, and the Authorities had the right to take it away immediately a driver showed that he was unfit to drive. All along, the Act had permitted the magistrates to withdraw the right to drive to any man who proved that he was not a proper person to be entrusted with that right. How had the Judicial Authorities used their powers? He considered the essence of the trouble was the absolutely wrong way in which the Act had been administered by the Judicial Authorities. He could not altogether blame them; in his opinion they were the wrong persons to be entrusted with that power. His point was that the power was there if it could only be made effective. With regard to drunkenness: local Benches had over and over again had before them men guilty of drunkenness while in charge of a motor-car. Some were fined £2, some were threatened with imprisonment, and some were imprisoned, but there was no uniformity of action, and very few Justices exercised the one punishment that they should enforce, which was to take away the drunkard's licence. It seemed to him that if there was any type of man who should not be permitted to drive a motor-car, it was the man who got drunk. What good did it do to send such a man to prison? He came out at the end of a month still less able to exercise self-control. His licence to drive should be taken away, and a permanent danger would thereby be removed.

Fortunately, Earl Russell had carried through an amendment to the Criminal Law Amendment Bill, making such procedure compulsory. In future, for that particular offence, the suspension of licence would operate automatically on conviction. Broadly speaking, that was how the licensing question should be dealt with. He would like to see set up a small expert Commission, who should superintend the suspension of licences. Every person convicted for driving to the danger of the public should *ipso facto* forfeit his licence, which he could only recover again if he could satisfy an expert

Commissioner that he had redeemed his character and could be trusted to drive with consideration for others.

Another great need was for better-designed roads. The difficulty in Great Britain was that many miles of important roads were without any footpath at all. Two charrs-à-bancs passing absorbed the whole of the road, and the unfortunate pedestrian was pushed into the ditch. It was important that footpaths be provided on the main roads. He would like to see trees in between the footpaths and the roads, so that wherever it was possible, without any great expense, there should be a gap between the normal footpath and the road.

The law about pedestrians had to be reconsidered; it must be enforced much more strongly against the motorists on roads where there were no proper footpaths. On the other hand, the pedestrian must be limited as to his right to use a road where proper footpaths were provided.

In the meantime, both pedestrians and motor drivers had to be educated. One of the proposals of the Departmental Committee was to print on the back of every licence issued to a motor driver the rules and courtesies of the road, and that the licence should be signed at the foot of the rules before it became valid. The pedestrian had to be taught also. The rules and courtesies of the road should be taught in every public elementary school in the land. There were other ways in which the public should be educated.

Mr. Jeffreys said he was a golfer, and as a class golfers were supposed to be fairly well educated. He visited a good many golf links and he found the most elementary rule which was taught to every golfer from the first, "Please replace divots," had to be repeated on every course. Every golfer had to be reminded of the most elementary rule of golf. In addition to the white line, he suggested that pedestrians should be educated by putting "Look before you cross" in white letters on the pavement. A great deal could be done by education to develop the road sense in both pedestrians and drivers.

Referring to Major Edge's second recommendation, he (Mr. Jeffreys) was afraid he was also opposed to this, but there was not time to go into this fully on the present occasion. He expressed his thanks to the Society for the invitation to attend the meeting. The development and regulation of motor traffic, and the co-ordination of all traffic, was one of the most interesting subjects that had to be dealt with at the present time. He was very glad to be of any assistance he could to the Society.

Dr. HERON joined with the other speakers in expressing appreciation of the very hard work which Major Edge had put into his paper, in spite of the fact that he could not accept all Major Edge's conclusions or agree that his data were always correct.

Major Edge's recommendation that every driver should pass a driving test had been so fully discussed that it was not necessary

to say much more, and he could only add one point, that Major Edge had made such use of mortality statistics that perhaps it was fair to ask him why the mortality in New York was 50 per cent. more than in London, when the driving test was in operation in the former city and not in London.

With regard to the second recommendation, insurance against mechanical defects presented many difficulties, especially in old cars. Was Major Edge advocating insurance against mechanical defects, or insurance against accidents to third parties due to such defects? These were two quite different things. It was surprising, indeed, to find third-party insurance added as an afterthought.

There were many points in the paper that could be criticized. In the first table, on p. 406, the heading was "Motor Traffic."* That title was not wide enough, because the deaths given there included deaths from tramways and traction engines, and the heading should be amended. If the deaths from horse-drawn vehicles and motor traffic were added together it would be seen that the deaths from both classes of vehicles had increased from 1,274 in 1904 to 2,685 in 1923, a comparatively small increase when the great increase in traffic was taken into account.

The table of Deaths of Children on p. 409 was unsatisfactory, as the data on pp. 427-8, from which the figures were obtained, were incomplete and inaccurate so far as children were concerned. It was more significant, however, to take deaths from motor-cars only. On p. 427 it was stated that in 1904 there were 56 deaths of all ages from motor-cars, and only 13 deaths of children, whereas in 1923 the numbers were 834 and 164 respectively, thus showing little change in ratio. It was hardly fair, however, to take all classes of deaths together as had been done, because traction engines and tramcars supplied special problems that should be considered.

Dr. STEVENSON said he had been interested in the paper because he had taken up the same subject recently for the Registrar-General's Annual Review. His own point of view was a little different from that of Major Edge, in that he had gone in largely for analysing the character of the mortality, its age and sex distribution, as caused by each type of vehicle, with a view to seeing what people were killed by the motor-car, motor-cycle, and so forth, and he thought the results were rather interesting. He had a table which showed, for instance, very clearly that the motor-cycle, which apparently, in Major Edge's view, was a specially dangerous vehicle, was the safest vehicle on the road so far as the general community was concerned. The motor cyclist did not kill the other road user; he killed himself not infrequently, but he was extraordinarily safe to other users of the road. In his table he analysed the fatalities due to different types of vehicle at each age per 1,000 caused by all motor vehicles, so the table showed by what vehicles persons of a given age were killed.

* This has now been altered.

Taking all ages together, the motor cyclist caused 10 per cent. of the total fatalities. As compared with that, the proportion at different ages was as follows :—

Age	Per cent	
0— 5	3·8	
5—10	1·9	The age at which the deaths from all vehicles, 17·3 per cent. of the total, were most numerous.
10—15	1·3	
15—20	13·2	} Including the motor cyclist himself, who accounts for the rise.
20—25	28·3	
25—35	23·7	
35	14·6	
45	11·3	

The proportions at higher ages again falling below the general average of 10 per cent.

For this reason he contended that the motor cyclist was by far the safest man on the road so far as the general public was concerned.

It was very often the motor-car driver who remarked what dangerous vehicles motor cycles were, but the motor-car had proportionately many more pedestrian victims. It *selected* young children and aged people for death. Taking all ages, the motor-car was responsible for 35·4 per cent. of the total fatalities, and the proportion at different ages was as follows :—

Age.	Per cent.
0— 5	41·9
5—10	44·5

It then fell to a minimum of 19·8 at 20—25, afterwards rising to exceed the general average of 35·4 once more at ages over 55, when the figures were :—

Age.	Per cent
55—65	38·2
65—75	41·5
75 onwards	45·6

These figures, the converse of those for the motor cycle, showed that the motor-car driver was not killing mainly himself and his passengers, but people he ran over on the road.

In his experience popular opinion was entirely in the wrong as to the relative danger of different motor vehicles, but the

reason for the safety (to others than the rider) of the motor cycle was pretty obvious. Anyone who had been on a motor cycle knew perfectly well what control of the machine the motor cyclist had. He could swerve and dodge. The motor cyclist did not run into the child, because he swerved past. He had even the option of throwing himself off his machine if necessary, but the car in such a sudden emergency was dependent upon its braking power, and upon that alone, because it could not swerve. As to the efficacy of braking power as a life-preserving agency, he thought the point referred to by Sir Edgar Harper, as to the remarkable safety of the tramcar, was a good illustration. The tramcar was four times as safe as the motor omnibus. He had taken his facts from tables supplied by Major Edge of the number of passengers carried, and he thought that comparison was the true test. Number of vehicles was not a fair basis on which to compare the safety of the tram and the omnibus; it evidently took many more omnibuses than trams to move the same volume of traffic, and surely, therefore, seeing that mileage in itself implied risk, the vehicle which used less mileage to accomplish the same object was to that extent the safer vehicle. If compared on that basis (deaths per million passengers carried), the tramcar was about four times as safe as the motor omnibus in London.

He thought it was better to restrict the comparison to a single large area where the conditions were similar for all classes of vehicles; if the whole country were considered, motor omnibuses were largely operating on country roads. If congestion itself were a means of safety, as suggested in the paper, he asked why the death-rate was higher in London than it was in the country at large?

Taking the distribution of the victims of the tramcar by age, it caused 3·5 per cent. of the total fatalities at all ages, with the following ratios for children:—

Age.	Per cent
0—5	5·6
5—10	1·2
10—15	1·2
15—20	0·9

The reason for these low rates in childhood was obvious. The tramcar could not dodge like the motor cycle, but it could stop short. It was the enormous reserve of braking power that made the tramcar such a remarkably safe vehicle as it evidently was. Surely that pointed the way to making the motor-car safer than it was at present, and the tendency of the last year or two to fit four-wheel brakes would do a great deal towards diminishing fatal accidents, and especially accidents to young children, because the most careful driver might be confronted with the unexpected young child, and no one could foresee what a child between the age

of 5 and 10 would do. The vehicle that could stop quickly would certainly kill fewer children.

He had intended to say something about Major Edge's suggestions, but it had been already said by much more competent speakers than himself. He felt, mainly as the result of self-analysis, that he did know something of the qualifications of a bad driver, and he believed they were far more temperamental than technical. Temperament could not be examined. He himself had been examined for a driving licence to drive on the Continent, and he would say without hesitation that the examination was a farce, and any such examination was bound to be a farce, as a man was naturally on his good behaviour under examination, and how was the examiner to know what would happen on the road?

Major Edge spoke as if there were only two qualifications—technical ability and road sense. He maintained that there was a third qualification, more important than either, and that was temperament. One of the constantly recurring crises was that caused by the gentleman who came round a sharp corner on the wrong side of the road. Was that technical inability or lack of road sense? It was neither. He might be a well-qualified driver technically, and skilled in gauging speed, but he did not bother to observe the rule of the road. He was the type of man who preferred to take a certain amount of risk, and no examination could eliminate him; he must be dealt with as had already been suggested by Mr. Rees Jeffreys.

Dr. GREENWOOD said he would like to add one small point. He had no knowledge whatever of motors excepting from riding behind Dr. Isserlis' motor bicycle, and, after listening to Dr. Stevenson, he would consider seriously whether he should do so again. It seemed to him, however, that on one statistical point there was a little misunderstanding.

Sir Edgar Harper suggested that it was the ratio of deaths to the number of vehicles that was really wanted. In Dr. Greenwood's view that ratio, which was actually given by Major Edge, who had used the only figures available, was of little value. Mr. Wilson had put his finger on the spot. The two tables on pp. 415-16 did *not* mean that a motor vehicle in London was far more deadly than elsewhere. The ratio formed was of the number of deaths in an area to the number of vehicles *registered* in that area. There was no law preventing a vehicle passing through the County of London unless it had been registered in that area.

What was required was something analogous to train-miles, but there was no possibility of getting it.

He did not agree with the speaker who regarded Major Edge as too much of an alarmist; he would not have felt reassured during the more severe air raids if someone had pointed out that the ratio of deaths to the number of aeroplanes dropping

bombs was going down. The trouble was that the absolute number of deaths was increasing.

Another point was that it did seem to him rather strange that there was not more information with regard to the details of deaths caused by motors. Dr. Stevenson had produced extremely cogent indirect evidence, but he wondered why the coroners' returns did not supply direct evidence. Apparently information was not supplied as to whether it was the boy standing in the street or the boy sitting next to the driver who was killed in an accident. If that information were really not supplied, it surely ought to be, in order that the statistics might be more exact.

Mr. J. C. SPENSLEY said that, so far as Greater London was concerned, an analysis was made under about 30 different heads of possible circumstances in which fatal and non-fatal accidents occurred. Particulars were taken as to whether the accident occurred to the occupants of the vehicle or to persons entering or alighting from vehicles in motion, crossing roads, passing between moving or stationary vehicles, stepping off the kerb, walking in the roadway, etc., and all these circumstances were recorded both for motor and for other vehicles. This pointed to one of the criticisms he had to make, namely, that there was a good deal of information available that had not been utilized for the purposes of the paper. In some instances the statistics used were two years late; he saw no figures in the paper relating to a year later than 1923, although statistics were generally available for 1924, and under some heads for 1925.

On pp. 414-15 the question of registration and licensing of motor vehicles was mentioned. He agreed with the writer that the figures for motor licences before 1920 were incomplete and were not comparable with the later figures, since commercial motors were not licensed prior to the Act of 1920. Commercial motors, though not licensed, were registered, but the statistics of registrations were of little use by themselves, since a motor once registered remained registered, whether it was in use or not; it only had to be entered in the register again when it changed ownership. These conditions would invalidate any direct comparisons between deaths from motor vehicles and the number of motor vehicles registered. The best figures were those relating to licences issued under the Act of 1920, since which date all motor vehicles had been licensed and figures were available in considerable detail relating to the different kinds of vehicles. Unfortunately these data had not been used for the paper.

He did not understand why the war years had been omitted altogether; if there had been a great change during those years it would have been interesting to note it.

He had intended to say a number of complimentary things about the paper, as well as to criticize it, but there was no time for compliments at such a late hour.

His sympathies were very much with Major Edge's pedestrian point of view, and he would like to join in thanking him for raising an exceedingly interesting subject.

Mr. UDNY YULE said he only viewed this subject from the standpoint of the unfortunate pedestrian. When notices were put on the pavement to warn pedestrians to "Look before you cross," he would also hope that notices would be put up for the motorists, "Please replace the pedestrians."

The discussion had been a most interesting one, and the Society owed its thanks to Major Edge. As, however, time was getting on, he would content himself with putting the vote of thanks to the Society, which vote was carried unanimously. Mr. Yule now called upon Major Edge to reply.

Major EDGE, in reply, said he would confine his remarks to thanking the Society very warmly for the kind reception given to his paper and for the very kind expressions made by the proposer and seconder of the vote of thanks, which he felt sure were much warmer than the paper deserved. He would reply to the various queries raised in a note for inclusion in the *Journal*.

Mr. S. CHAPMAN, who was unable to stay until the end of the meeting, sent the following remarks:—

In comparing our experience with that of the U.S.A., I think it will be found that, having in mind the number of vehicles licensed, our accidents are proportionately much more frequent.

If we take the relatively favourable figures for 1920-1, shown on p. 414, viz. 3.9 deaths per 1,000 motor vehicles, and then turn to the first table on p. 432, we find that deaths in the U.S.A. for 1921 were 11,628, and, as there were 10,465,995 registrations in that year, this gives only 1.1 per 1,000 vehicles. If we take 1922, with 12,238,375 vehicles and 13,157 deaths, there is a slight improvement per 1,000 vehicles, which might be taken as supporting the argument on p. 424, that in congested traffic areas the risk appears to be less.

This, however, would be an incorrect conclusion, and it is only necessary to refer to the last table on p. 432 to see the exceedingly high and increasing figures for Los Angeles.

In this city, with a population of approximately three-quarters of a million, there are over 150,000 motor registrations. If we had similar density of motor traffic here we should have more registrations in London alone than we have for the whole of England and Wales. There is, however, another fact to be taken into consideration in making comparisons with the U.S.A., in that the mileage per vehicle is much greater than here. To run an omnibus between London and Bristol is regarded as something exceptional. We have nothing in this country to compare, for instance, with the regular omnibus services between San Francisco and Los Angeles, leaving each morning and evening and arriving at their destination the same

evening and following morning respectively, after a journey of 470 miles—or further than London to Perth—in less than 16 hours. Even longer distances are covered by public vehicles, *e.g.* between New York and Miami, and private owners also cover longer distances and at greater speed than we do here.

If American accidents were compared with ours on a mileage basis we should make a much worse showing, and the explanation is probably due to the fact that licences in most parts of the U.S.A. are not obtainable so readily as they are here.

The following reply has been received from Major Edge since the meeting:—

Sir Edgar Harper, in his opening remarks, commented upon the peculiar nature of the comparison I had permitted myself—namely, that of cancer and motor mortality. Motor accidents are, however, no less a *cause* of death than are scarlet fever, measles, bronchitis, or any other malady mentioned in the official nomenclature of causes of death in use in this country. Cancer was selected for comparison because the increase of deaths attributed to this cause is so frequently referred to in the daily press, while the increasing mortality due to motor traffic has, so far, received but little notice. The fact that motor traffic is but a generation old seems to me hardly relevant; any *cause* which tends to produce a high mortality rate demands the immediate attention of the public authorities if the mortality from that cause is to be diminished. I cannot feel that the method suggested of relating numbers of deaths to numbers of motor vehicles would really prove a better measure of the mortality due to mechanically propelled vehicles than is the method of calculation presented in the paper. This proposal has been frequently advocated by motoring enthusiasts of countries other than our own, and, if adopted, it would make the present situation *appear* less serious, but would not alter the fact that mechanically propelled vehicles *do* kill an increasing number of the citizens of this country every year. The percentages referred to by Sir Edgar Harper were taken from the Report of the Commissioner of Police of the Metropolis for the year 1924, and were evidently calculated from the results obtained by the annual traffic census taken by that Authority at 80 selected busy points in different parts of London.

Mr. D. R. Wilson criticizes the range covered by the investigation, and suggests this selection has provided me with an opportunity for playing the part of the alarmist. The following considerations led to the selection of the period 1904–23. For the years prior to 1906, I found it impossible to distinguish between motor-cars, hackney motors, etc., for the whole area, England and Wales, but discovered that, in London, in 1904, out of 3,922 four-wheeled carriages (*i.e.* cabs) licensed by the Commissioner of Police, *only 2 were mechanically propelled*, while out of 3,581 omnibuses licensed in the same year and by the same authority, *only 31 were mechanically propelled*; the disproportions were so pronounced—and it was not

unreasonable to assume they would be equally great throughout the country—that they seemed to suggest that 1904 could be taken as the year of introduction of the motor vehicle plying for hire, and vehicles plying for hire supply a considerable factor in the street traffic problem. In continuing my preliminary enquiry, the only official data at my disposal at the time enabled me to carry the investigation up to the year 1923. For these reasons, therefore, the period 1904–23 was determined upon, giving a complete range of exactly twenty years. In concluding my remarks under this point I would add that, in 1906, the year in which Mr. Wilson would have commenced such an enquiry, out of 3,940 four-wheeled hackney carriages, and 3,747 omnibuses in London, *but 96 of the former and 783 of the latter* were mechanically propelled, so that, even in 1906, motor traffic formed a very inconsiderable proportion of the bulk of street traffic in the metropolis. The tables referred to by Mr. Wilson on p. 436 merely represent motor vehicles *registered* by the London County Council, and do not approximate to the numbers of motor vehicles using London streets, since vehicles registered outside the limits of the London authority are at liberty to use the thoroughfares of the metropolis (the same is true, of course, of all other areas). I imagine Mr. Wilson has misunderstood my attitude towards the motoring novice in charging me with the opinion that the beginner is a careless person. The beginner is, no doubt, usually over-cautious, yet, at best, has but incomplete mechanical control of the car he is driving; his reactions are too slow and too uncertain, and the vague apprehensions which *must* characterize his early driving experiences may not infrequently result in accidents.

Mr. Rees Jeffreys denies that knowledge and skill are governing factors in the prevention of street accidents caused by motor vehicles, but holds that the controlling factors in the problem are “judgment and consideration.” But, surely, judgment and consideration are correlated with knowledge and skill. Judgment is a very complicated mental process, and we judge best about the things we *know* best, our ability to judge well being entirely dependent upon our having, in the first instance, clear and definite knowledge of the things we are called upon to judge. In the absence of clear and definite knowledge, only very defective judgment is possible, and defective judgment can only give rise to vague apprehension. Vague apprehensions in their turn, are apt to be manifested in a very special manner in the problem under consideration, namely, by the almost inevitable development into accident. If, in the opinion of Mr. Rees Jeffreys “judgment and consideration” are controlling factors in the prevention of motor accidents, he would appear to support my contention that technical skill and knowledge should be insisted upon, since accurate judgment is impossible without technical knowledge. A good lawyer *may* be a bad judge, but a bad lawyer *must* be a bad judge. The temporary cancellation of the driving licence as suggested by Mr. Rees Jeffreys for traffic offences seems to me an inadequate punishment. Reference to

the opinions expressed by the legal advisers to the Home Office and to the Commissioner of Police indicate the view that, in the opinion of these authorities, sentences for traffic offences are in all cases too mild. Mr. Rees Jeffreys does not explain how any driver deprived of his licence for an offence of the traffic regulations would convince the Commissioner that "*he had redeemed his character and could be trusted to drive with consideration to others.*" Such a task would appear to call for something more than human ingenuity and talent on the part of the examining Commissioner.

Although I have visited New York on several occasions, and have therefore some acquaintance with traffic conditions in that city, I lack the specialized knowledge which would enable me to meet Dr. Heron's question relating to the higher mortality in New York, where the driving test is in operation; my reasons are, therefore, purely conjectural. It occurs to me, however, that part of the explanation might lie in the higher proportion of motor vehicles per head of population in the American city. I believe that, in New York, the proportions in 1923 were something in the nature of 1 car to every 11 persons of the population, whereas, in London, in the same year, the proportions were approximately 1 car to 38 persons. In view of the almost incredible congestion of motor traffic in and about Manhattan Island and at the approaches to the bridges connecting Long Island (a congestion which, in the opinion of some traffic authorities, nearly approaches saturation point in those areas), it would be interesting to know the distribution by area of the fatal motor accidents in New York. What increases the difficulty of explaining the reasons for this high motor fatality is the fact that, in New York, few push-bicycles are seen, and horse-drawn traffic is almost extinct, yet both of these factors are considerable features of London traffic. So far as London is concerned, I am inclined to the belief that the irregularity of our street plan serves, in some measure, to promote caution on the part of drivers. My suggestions relating to insurance involved both compulsory insurance against third-party risks, and compulsory insurance against accidents to third parties arising from mechanical defects. It seems to me disgraceful that the victim of an accident caused by the negligence or recklessness of the driver, or through mechanical weakness of the vehicle, can find no means of financial compensation for injury where the offending driver or owner can plead lack of assets. On the other hand, would the introduction of such measures develop a greater evil by making reckless drivers even more reckless? Dr. Heron's suggestion that the title for the table on p. 406 should be amended is welcome, and will be acted upon. In so far as the deaths of children are concerned, I would ask Dr. Heron's consideration of the motor-van peril as well as that arising from the motor-car; only 1 child was killed by a motor-van in 1904, against 128 in 1923.

Dr. Stevenson has come to the conclusion that the motor cyclist is the safest driver on the road, so far as the general public is

concerned. But the fact that the motor cyclist kills himself or his passenger occasionally is material. The average motor cyclist is a young adult, and of economic value to the country; should he not be restrained from recklessly throwing away his life and imperilling that of his passenger? As to the fact that the motor mortality-rate is higher in London than in the country, I would again remark that, in comparing the death-rate per 1,000 vehicles for England and Wales, all registered motors are related to all motor-traffic deaths, and compared with mortality-rates obtained by relating the numbers of all motor vehicles *registered in London* to all deaths in London caused by such vehicles; a considerable, but unknown, number of motor vehicles, *other than those actually registered by the London County Council*, are daily using London streets and roads; it does not follow that London traffic is more deadly than that of the country in general. In the matter of examination to prove technical efficiency, we continue on debatable ground. The question of temperament, however, affects other occupations besides that of the motor driver, as for example, that of the engine driver, the actuary, or the medical man; yet it is never suggested that examinations in these cases should be discontinued because persons might prove temperamentally unfitted for their vocations although they had proved their technical efficiency.

It had been my intention to refer to the investigations into road accidents conducted by the Ministry of Transport; and to the reports published by that Authority; presumably these are the reports referred to by Mr. Spensley in the course of his remarks. These reports, however, have made their appearance only in recent years, and cover but a very small proportion of the total numbers of fatal road accidents. It is true my paper contained no *detailed* figures relating to 1923 for the County of London: such figures were not at my disposal when the paper was originally submitted. On personal application being made to the London County Council, I was informed the data relating to 1923 would appear in a forthcoming publication, and I was courteously supplied with a proof-page of such figures. In view of the fact that the volume had not officially made its appearance, I felt it would have been improper to include the figures given me, and in any case, these figures reached me only a day or two prior to the date on which the paper was read. I think Mr. Spensley will find in the Appendices to the paper, data relating to the numbers of motor vehicles registered by the London County Council annually since 1920.

Mr. Chapman's references to the high motor mortality in Los Angeles, call for comment. Los Angeles has probably the highest percentage of motor ownership in the world—approximately 1 car to every 3 persons comprising the population of that city; add to this a climate which permits the use of cars for practically every day throughout the year, consider the phenomenal growth of the city, and reasons for this high traffic mortality begin to suggest themselves.

In conclusion, in spite of its many and obvious short-comings, the paper seems to have succeeded in stimulating the lively discussion of a problem of urgent and pressing importance. No one will deny the incalculable benefits which have followed in the wake of the development of the motor vehicle, which has wholly changed the conditions of the transport problem, and upon which many essential public services are now entirely dependent. Our country has not yet attained its maximum use of this form of transport. The questions are, whether the increased menace to life and limb is too high a price to pay, and whether the price might not be reduced? The motor manufacturer, agent, driver, local authority, and pedestrian alike, are all concerned to answer these questions. My investigation suggests that there is room for very considerable improvement in the presentation of the statistics relating to traffic accidents, and there would appear to be no sufficient reason why adequate statistics should not be supplied indicating, when, and under what circumstances accidents occur: state of the road; age and sex of the victim; whether the accident were due to fault on the part of the victim, recklessness or negligence on the part of the driver, etc., and so on. Such statistics might enable preventive regulations to be formulated.

The candidates named below were elected Fellows of the Society :—

David Arlott.

Jack Bass.

Alfred T. Chenhalls.

Percy George, B.A., B.Sc.

Alfred E. Hazelden.

Joseph Oscar Irwin, M.A., M.Sc.

Andrew Kefalas, M.B., Ch.B.,
F.R.M.S.

Ernest James Martin.

K. C. Purkayastha, M.A.

William Edward Richards.

Harry Threlfall.

STATISTICS OF BRITISH SHIPPING.

By HENRY W. MACROSTY, O.B.E., B.A.

[Read before the Royal Statistical Society, April 20, 1926,
M GREENWOOD, Esq., F R C P., in the Chair.]

TO-DAY is a day of challenge to all institutions, even to the once sacred Blue Book, and they are called upon to show a justification for their existence. It may not be amiss, therefore, to devote an evening to the examination of the official publications relating to one of our greatest industries, shipping, an industry which is most intimately bound up with the greatness of the Empire, and to see whether out of them an account can be constructed which is of real importance to the community. If that cannot be done, it follows that these publications, in their present form at least, are of little use, and should be either amended or abolished. The documents to be dealt with are the *Annual Statement of the Navigation and Shipping of the United Kingdom*, of which the latest issue, published in January, 1926, relates to the year 1924; the tables in the monthly *Accounts relating to Trade and Navigation of the United Kingdom*, showing the net tonnage and nationality of vessels with cargo which entered or cleared at British ports from or to fourteen specified areas; the monthly articles in *The Board of Trade Journal*, showing by nationalities the net tonnage of the vessels that arrived at or departed from British ports with cargo or in ballast; the *Return of the Number, Ages, Ratings and Nationalities of Seamen*, giving the results of the quinquennial Census of Seamen, last taken in 1921; and the monthly white paper showing the alterations in the registry of shipping. In the elucidation and utilization of these publications use has been made of information collected by or for the industry itself, and, in particular, of the Annual Review of freight rates in *The Daily Freight Register*, published by Comtelbuoro, Limited.

Definitions.

It may be advantageous to begin with definitions of some terms which will appear frequently in the following pages and have a technical significance not always understood. All British ships are required to be enrolled on the Register under Part I of the Merchant Shipping Act, 1894, except vessels not exceeding 15 tons burthen employed solely in river or coastal navigation in the United Kingdom, Irish Free State, or a British Possession where their managing owners are resident, and ships not exceeding 30 tons burthen, and not having a whole or fixed deck, and employed solely in fishing or trading coastwise off Newfoundland or the Gulf of St. Lawrence. "Burthen" means net register tonnage. The ton used in the measurement of ships is 100 cubic feet, and the gross tonnage is the internal capacity of the ship; net tonnage is the gross measurement less space for the crew, engines, boilers, and bunkers.* Both measurements are made under certain complicated technical rules, and there is no undeviating relation between them, while neither gross nor net tonnage bears a definite relation to the dead-weight carrying capacity of a ship. Port and dock dues are charged on net tonnage.

Vessels are deemed to be in ballast when they carry only passengers and their baggage or, in the Foreign Trade, no goods other than chalk or slate, and since January 1, 1907, vessels arriving at or departing from a port in the United Kingdom without landing or shipping cargo are recorded as "in ballast." Vessels from abroad with cargo for the United Kingdom are recorded as coming from the first port at which cargo was taken on, and vessels "sailing foreign" with cargo are treated as departing for the last port to which cargo is consigned. Vessels arriving from abroad without cargo or passengers for the United Kingdom are recorded as arriving from the last port of call, and those departing for abroad without cargo or passengers as departing to the first port of call; but vessels from abroad landing or embarking passengers only at a British port are recorded as "in ballast" from or to the most distant port from or to which passengers are conveyed on that voyage. In those tables of the Annual Statement of Navigation which deal with the United Kingdom as a whole, vessels which arrive from abroad and call at several ports in the United Kingdom are recorded as "entered" at one port only (usually the first port of discharge), and vessels which load at several British ports before departing for abroad are recorded as "cleared" from

* See Note 1, p 542.

one port only (usually the first loading-port). In the tables dealing with individual ports, however, and in the coasting trade, the "arrival" of a vessel at, and her "departure" from, each port of call is separately recorded for each port.

Vessels on the Register.

The position of our shipping industry before the war, at the close of the war, and at the end of 1924 is indicated below, the figures showing the number and net tonnage of sailing and steam (including motor vessels) remaining on the registers at ports of the United Kingdom, Isle of Man, and Channel Islands on December 31 of the years specified :—

	December 31, 1913		December 31, 1918.		December 31, 1924.	
	Number	Net tons	Number	Net tons.	Number	Net tons
Sailing vessels	8,336	846,504	6,856	603,916	5,842	521,987
Steam and motor vessels	12,602	11,273,387	11,334	9,496,970	12,513	11,194,448
Total	20,938	12,119,891	18,190	10,100,886	18,355	11,716,435

The net effect* of the war was to reduce British vessels by 2,748 of 2,019,005 net tons, and during the subsequent six years the number of vessels was increased by 165 and the net tonnage by 1,615,549 net tons. The increase in the latter period would have been greater but for the transfer after April 1, 1923, to the Irish Free State of a certain number of vessels; there were on the registers of ports in the Irish Free State on December 31, 1922, 200 sailing vessels of 10,983 net tons and 354 steam and motor vessels of 55,425 net tons. How the increase between the end of 1918 and the end of 1924 came about is shown in the following table.

* See Note 2, p 542

Changes in the net tonnage on the registers at ports in the United Kingdom, Isle of Man, and Channel Islands between December 31, 1918, and December 31, 1924.

ADDITIONS.

Cause	Sailing vessels	Steam vessels.	Total.
Built in United Kingdom	68,228	3,815,807	3,884,035
Built in Dominions	—	72,107	72,107
Purchased from foreigners	36,806	471,942	508,748
Transferred from British ports outside the United Kingdom	6,590	164,903	171,493
Other vessels	123,467	2,566,830	2,690,297
Re-measurement	205	69,614	69,819
Total	235,296	7,161,203	7,396,499

DEDUCTIONS.

Wrecked, etc.	42,380	532,345	574,725
Broken up*	45,365	104,701	150,066
Sold to foreigners	102,419	2,975,728	3,078,147
Transferred to British ports outside the United Kingdom	16,208	421,603	437,811
Other vessels	100,508	1,195,681	1,296,189
Re-measurement	1,045	192,425	193,470
Transferred to Irish Free State	10,983	55,425	66,408
Total	318,908	5,477,908	5,796,816

* See Note 3, p. 543.

Combining these deductions with the preceding additions, we get a net deduction of 83,612 net tons in sailing vessels and a net addition of 1,683,295 net tons in steam and motor vessels, or an increase of 1,599,683 net tons in all vessels. This aggregate is less than that shown by actual count of the register on December 31, 1924, by 15,886 net tons, but the difference is purely technical; vessels are continually being transferred from the registry at one port in the United Kingdom to that at another, and time elapses between the recording of the de-registry and the re-registry; over the six years the technical additions due to transfers were 1,491,658 net tons and the technical deductions 1,475,783 net tons, an apparent surplus of additions amounting to 15,875 net tons.

The net addition to the British mercantile marine in the six post-war years 1919-24 was at the rate of about 269,000 net tons a year, while in the three pre-war years the net addition was about

188,000 net tons a year. In the earlier period the addition of new British-built vessels was greater, 816,000 net tons a year instead of about 647,000 net tons, but the purchases from foreigners were less, being only 34,000 net tons a year against nearly 85,000 net tons in 1919-24; on the other hand, the transfers from British ports outside the United Kingdom were at the rate of 10,000 net tons a year in 1911-13 against about 29,000 net tons a year in 1919-24. Wrecks were fortunately less frequent in the later period, averaging about 96,000 net tons a year, against 145,000 net tons, and vessels broken up were somewhat less at 25,000 net tons a year against about 36,000 net tons. Sales to foreigners averaged about 513,000 net tons a year in 1919-24 against about 464,000 net tons in 1911-13, and transfers to British ports outside the United Kingdom were about 73,000 net tons a year against about 33,000 net tons. The heading "Other Vessels" includes, normally, among additions, such items as late registry of ships and transfers from inland navigation; among deductions, such items as voluntary surrender of registry and dismantled vessels; and, on both sides, conversions from sailing to steam or motor vessels or the reverse. In later years this heading has also covered entries in respect of a large number of vessels (chiefly ex-enemy ships) which were provisionally registered during and after the war; the provisional register was subsequently closed and the vessels were re-registered. The actual addition to our Register in respect of ex-enemy ships surrendered and prize ships is not known, but the total number and tonnage of reparation ships put at the disposal of the British government were 18 sailing vessels totalling 38,915 gross tons, 392 steam and motor vessels totalling 1,907,100 gross tons, and 29 fishing vessels totalling 6,650 gross tons, besides 66 prize ships totalling 171,828 gross tons; in all, 505 ships of 2,124,583 gross tons. Ex-enemy ships transferred to foreigners and vessels returned by the Shipping Controller were treated as if sold. Many of the ex-enemy ships added to our Register were subsequently sold, especially to Germany, and this fact accounts to some extent for the increase in "sales to foreigners" after the war.

Sales to foreigners.

The monthly white paper "Registry of Ships," known as "G.R. 128," gives particulars of changes in the registers of the United Kingdom, British Overseas Dominions and Protectorates, and annual summaries of the total changes in the year are included in the December issues. For the six years 1919-24 the total sales to foreigners of vessels on the United Kingdom register are shown as

2,978,063 net tons of steam and motor vessels and 103,813 net tons of sailing vessels; the small differences between these figures and those derived from the Annual Statement of Navigation are due to subsequent corrections. The twelve leading purchasers and the tonnage bought by them in the six years 1919-24 were as follows :—

	Steam and motor vessels.	Sailing vessels.	Total.
	Net tons.	Net tons.	Net tons.
Italy	488,799	9,572	498,371
Germany	422,677	10,695	433,372
France	298,179	13,660	311,839
Greece	299,519	2,236	301,755
Norway	265,302	22,354	287,656
Holland	252,366	5,338	257,704
Japan	251,331	—	251,331
Belgium ...	198,327	14,759	213,086
Spain	131,125	5,231	136,356
Russia ...	51,546	4,175	55,721
United States ...	53,870	12	53,882
China	38,098	352	38,450
Other countries ...	226,924	15,429	242,353
Total . . .	2,978,063	103,813	3,081,876

The Register at December 31, 1925.

The issue of "G.R. 128" for December, 1925, contains provisional figures of the vessels remaining on the register of the United Kingdom on December 31 of that year, viz. 10,542 steam-ships of 10,972,892 net tons, 1,969 motor-ships of 493,712 net tons, and 5,806 sailing-ships of 519,266 net tons; total, 18,317 ships of 11,985,870 net tons. These figures are subject to correction which, in the aggregate, is not likely to be large. First registry of new and other ships accounted for 652,216 net tons, 82,611 tons were purchased from foreigners, and 15,775 net tons were transferred from British Dominions. Chief deductions were: wrecked, 42,281 net tons; broken up, 38,299 net tons; sold to foreigners, 336,404 net tons; transferred to British Dominions, 110,299 net tons.

The passing of the sailing ship.

The European War altered many things, and it made a profound impression on the structure of our shipping industry, not only by the physical destruction of ships, but by hurrying up certain tendencies which had already become evident. The sailing vessel has now completely ceased to be a factor in our overseas trade. In 1900 there were still on the Register in the United Kingdom, the Isle of

Man, and the Channel Islands 10,773 sailing vessels of 2,247,000 gross tons in the aggregate; in 1913 they were reduced to 8,336 of 922,000 gross tons in all, and in 1924 they numbered only 5,842 of 561,000 gross tonnage (excluding those on Irish Free State register), and of these only 13, of 18,000 net tons in all, were employed during some part of the year 1924 in trading with countries outside the Elbe to Brest coast-line.

Classification of steam vessels.

Turning to steam and motor vessels registered in the United Kingdom, Isle of Man, and Channel Islands, the particulars given in the Annual Statement can be summarized as follows:—

Steam vessels registered in United Kingdom, Isle of Man and Channel Islands.

Class of vessel.	Number.			
	1913.	1920.	1923.	1924.
Under 1,600 gross tons	8,772	9,130	9,266	9,342
1,600 and under 5,000 gross tons	3,001	1,881	1,754	1,742
5,000 and under 7,500 gross tons	549	915	974	982
7,500 gross tons and over	280	381	443	447
Total	12,602	12,307	12,437	12,513

Class of vessel.	Tonnage, in 1,000 gross tons			
	1913.	1920.	1923.	1924.
Under 1,600 gross tons	2,339	2,252	2,262	2,304
1,600 and under 5,000 gross tons	10,136	6,320	5,800	5,785
5,000 and under 7,500 gross tons	3,275	5,415	5,826	5,871
7,500 gross tons and over	2,933	3,979	4,865	4,923
Total	18,683	17,966	18,753	18,883

After April 1, 1923, vessels registered in the Irish Free State were removed from the British Register, and by comparing the figures for Ireland as a whole at the end of 1922 and those for Northern Ireland at the end of 1923, we can put the loss at 341 vessels under 1,600 gross tons, aggregating 75,000 tons; 12 vessels over 1,600 and

under 5,000 gross tons, aggregating 31,000 tons; and one of 6,200 tons; in all, 354 vessels of 112,000 gross tons.

Besides vessels engaged in coasting and on the short sea routes to the Continent, the class of ships of lowest tonnage includes tugs, yachts, vessels registered both for trading and fishing, river-trade vessels, etc. It will be observed that the numbers of vessels in this class increased by about 6·5 per cent. between 1913 and 1924, but that the average tonnage per vessel fell from 267 to 247 gross tons. This phenomenon is due to the advent of the small motor-boat, of which there were in this class 1,570 in 1923 and 1,734 in 1924, with aggregate *net* tonnages of 54,000 and 59,000 net tons respectively.

Tramps and liners.

The next three classes cover the ocean-going steam- and motor-ships, the class of ships of 1,600 and under 5,000 gross tons being in the main "tramps," the class of ships over 5,000 and under 7,500 gross tons including most of the "cargo-liners," and the class of ships over 7,500 gross tons being dominantly "passenger-liners"; it is not pretended that the line between these three types of steamer can be drawn with absolute precision on a tonnage basis. The "tramp" class is the one which was most severely hit during the war, and its numbers have declined since then, so that in 1924 they were only 58 per cent. of the 1913 figure, and the average tonnage had declined from 3,378 to 3,321 gross tons. The recruitment of our trading fleet has taken place in the next two classes, where the tonnage of "cargo-liners" and "super-tramps" increased by 79 per cent. and the tonnage of passenger-liners by 68 per cent. between 1913 and 1924. The ocean-going mercantile fleet numbered 3,830 vessels in 1913 of 16,344,000 gross tons in the aggregate, and in 1924 its numbers had declined to 3,171 but the tonnage had risen to 16,579,000 gross tons. Motor vessels have not contributed largely, so far, to the efficiency of this fleet, but they are increasing; in 1923 there were 19 of 47,000 net tons in the "tramp" class (between 1,000 and 4,000 net tons), and 35 of 162,000 net tons, each over 4,000 net tons, while in 1924 there were 48 of 128,000 net tons altogether in the lower class and 41 of 197,000 net tons in the higher. There has been no very perceptible tendency to increase of size in the cargo-liner class, the increase in numbers being spread not unevenly over the various tonnage classes. The average measurement of the passenger-liner class has, however, risen from 10,475 gross tons in 1913 to 11,013 gross tons in 1924.

Gross and net tonnage.

It is of interest to attempt to trace the relation between gross and net tonnage in vessels of different sizes, and the following rough general comparison of classes of steamers in 1900, 1913, and 1924 reveals some matters of importance. It has only been possible to make the comparison for quite broad classes, and it would be a great improvement of the tables of gross tonnage and net tonnage contained in the Annual Statement of Navigation if against each class of steamers graded by gross tonnage there was shown also the aggregate net tonnage of the vessels in the class, and if, similarly, in the table of net tonnage there was shown also the gross tonnage of the vessels in each class. It has also to be explained that, in order to make the comparison as close as possible, it has been necessary to break up certain of the class groups shown in the tables, *e.g.* to divide the class of vessels of 4,500 net tons and over but under 5,000 net tons, so as to estimate the number of 4,500 net tons and under 4,750 net tons. This has been done as carefully as possible with due regard to the average tonnage of vessels in the group. Naturally, in the circumstances of the time, the tables for 1900 were not so detailed in the higher ranges as were the tables of later years.

The tables on pp. 461-2 show what has already been remarked, the decreasing importance of the vessel under 1,600 tons gross, and, since 1913, also of the vessel between 1,600 and 5,000 tons gross; in each of the other classes the average size of the vessel has increased. Comparing 1913 with 1900 we observe that the ratio of net tonnage to gross tonnage decreased in all classes, and that the decrease was continued in 1924 except in the first class and in the last two classes. This decrease may be related to two causes, increase in space allotted to crew, and the skill of the shipbuilder in constructing a ship with the greatest possible carrying capacity and at the same time the smallest net tonnage, as ascertained by the conventional rules, that is, the lowest liability to harbour and dock dues; of the two the latter is probably the more important. The increase in the ratio of net tonnage to gross tonnage in non-ocean-going vessels in 1924 is probably due to the large number of small motor-boats now included in the class, since their space for engines, boilers, and bunkers is smaller than the corresponding space in steam vessels of equivalent power. Similarly, the cause of the higher net tonnage of large passenger vessels relative to their gross tonnage, which appears in the figures for 1924, may be in part assigned to the prevalence of oil-burning steamers in this class. Account must also be taken of the operation of the Merchant Shipping Act, 1907, which came fully

1900.

Gross tonnage			Net tonnage.				Average net tonnage per 1,000 tons gross.
Class of ship	No	Thousand gross tons.	Average gross tons.	Class of ship.	No.	Thousand net tons.	Average net tons.
Under 1,600 tons and under	6,282	2,193	349	Under 1,000 tons	6,303	1,105	175
1,600 tons and under	2,611	7,487	2,868	1,000 tons and under	2,604	4,816	1,849
5,000 tons and under	245	1,453	5,931	3,250 tons	302	1,287	4,202
7,500 tons and over	71	684	9,634	3,250 tons and over			630
Total	9,209	11,817	1,283	Total	9,209	7,208	610

1913.

Gross tonnage			Net tonnage.				Average net tonnage per 1,000 tons gross.
Class of ship	No	Thousand gross tons.	Average gross tons.	Class of ship.	No.	Thousand net tons.	Average net tons.
Under 1,600 tons and under	8,772	2,339	267	Under 900 tons	8,777	1,025	117
1,600 tons and under	3,001	10,136	3,378	900 tons and under	3,002	6,424	2,140
5,000 tons and under	549	3,275	5,965	3,250 tons and under	557	2,101	3,772
7,500 tons and under	162	1,356	8,370	4,750 tons and under	143	754	5,273
10,000 tons and under	90	1,037	11,522	6,000 tons and under	93	652	7,011
14,000 tons and over	28	540	19,286	8,500 tons and over	30	317	10,567
Total	12,602	18,683	1,483	Total	12,602	11,273	895

1924

Gross tonnage				Net tonnage				Average net tonnage per 1,000 tons gross
Class of ship	No	Thousand gross tons	Average gross tons	Class of ship	No	Thousand net tons	Average net tons	
Under 1,600 tons	9,342	2,304	247	Under 900 tons	9,343	1,051	112	453
1,600 tons and under	1,742	5,785	3,321	900 tons and under	1,754	3,570	2,035	613
5,000 tons				3,100 tons and under				
5,000 tons and under	982	5,871	5,979	3,100 tons and under	977	3,626	3,711	621
7,500 tons				4,750 tons and under				
7,500 tons and under	263	2,210	8,403	4,750 tons and under	257	1,351	5,257	626
10,000 tons				6,100 tons				
10,000 tons and under	119	1,390	11,681	6,100 tons and under	117	844	7,214	618
14,000 tons	65	1,323	20,354	8,750 tons	65	752	11,569	568
14,000 tons and over				8,750 tons and over				
Total	12,513	18,883	1,509	Total	12,513	11,194	895	593

into operation in 1914, and affected the net measurement of steamers to a slight degree in the case of ordinary steamers, but greatly increasing the net tonnage of the large and speedy passenger vessels of the newest types. This change in the relation of net to gross tonnage will become more noticeable as the building of large motor vessels increases. Between 1913 and 1924 the ratio of net tonnage to gross tonnage in vessels of 1,600 gross tons and over but under 5,000 tons fell from 634 to 613 per 1,000 gross tons, while in vessels of 5,000 tons but under 7,500 tons it fell from 632 to 621 per 1,000 gross tons, and in vessels of 7,500 tons but under 10,000 tons it fell from 630 to 626 per 1,000 gross tons; this diminished rate of decrease in the larger vessels may be related in part to the use of turbine engines with their smaller machinery spaces. In the tonnage statistics there is thus found a clear statistical record of mechanical improvement.

The age-constitution of our ships.

Much of the efficiency of a fleet of merchant vessels depends on the age-constitution of the ships, and as age advances speed diminishes; nevertheless, this conclusion must not be taken too absolutely, for many an old vessel, if its original capital value has been properly written down and it has been kept in a proper state of repair, is able to run at a profit in trades where speed is not of the first importance when newer vessels would not be able to pay. Table I shows the age-constitution of steam vessels on the Register at the end of 1924 and at the end of 1913. They are not exactly comparable, for the latest time section in the one case includes four years and in the other case three years, but still broad comparisons are possible. The following table is compiled from the detailed tables in the Annual Statement:—

Steam vessels on Register at end of year.

[In thousand gross tons.]

Tonnage class.	1913.			
	Up to 5 years old.	Over 5 and up to 10 years old.	Over 10 and up to 13 years old.	Over 13 years old.
1,500 and under 3,000 gross tons	397	470	248	1,327
3,000 and under 5,000 gross tons	2,189	2,501	1,152	2,016
5,000 and under 8,000 gross tons	1,369	665	573	1,179
8,000 gross tons and over	959	583	377	503
Totals	4,914	4,219	2,350	5,025
	16,508			

Steam vessels on Register at end of year—Contd.

[In thousand gross tons]

Tonnage class.	1924			
	Up to 5 years old.	Over 5 and up to 10 years old	Over 10 and up to 13 years old	Over 13 years old.
1,500 and under 3,000 gross tons	568	273	129	731
3,000 and under 5,000 gross tons	681	596	749	2,228
5,000 and under 8,000 gross tons	2,073	2,173	830	1,488
8,000 gross tons and over	1,456	684	760	1,331
Totals	4,778	3,726	2,468	5,778
	16,750			

It will be observed that while the ocean-going steam tonnage which was not more than five years old was only 28·53 per cent. at the end of 1924, compared with 29·77 per cent. at the end of 1913, it consisted as to 73·86 per cent. of vessels of 5,000 tons gross and upwards, whereas at the end of 1913 only 47·37 per cent. was of that capacity. In each age-class the proportion of vessels of 5,000 tons gross and upwards was greater at the end of 1924 than at the end of 1913, and it is only in the smaller vessels that retrogression is shown. The older and slower vessels lost in the war were replaced by larger and more powerful ships. Considering the better mechanical equipment and the greater average tonnage of the more modern vessels, it is plain that the merchant fleet of 1924 was much more efficient than that of 1913; but, having regard to the diminished output of merchant ships since 1914 and particularly in more recent years, that efficiency will get smaller, unless a much more pronounced policy of scrapping old tonnage and replacing it by new is adopted than shipowners have felt themselves able to enter on in the lamentable economic circumstances of the past five years.

Entrances and clearances.

The most important tables in the Annual Statement of Navigation are those which deal with the entrances and clearances of vessels at British ports, distinguishing the nationalities of the vessels and the geographical areas with which they trade. These tables deal with vessels in ballast as well as with those carrying cargoes, and in the monthly Accounts relating to Trade and Navigation of the United

Kingdom corresponding tables are given, which, however, show only entrances and clearances of vessels with cargoes. Table II shows in summary form the principal particulars in the tables in the Annual Statements for 1912, 1913, 1920, 1923, and 1924, and the preliminary figures for 1925. As prior to January 1, 1912, mails were not regarded as "cargo," it has not been possible to extend the comparisons beyond that date. In this table particulars of entrances from and clearances to the Irish Free State have been omitted, since prior to April 1, 1923, they were included in coasting trade; movements between the Irish Free State and countries other than Great Britain and Northern Ireland, which before that date were included in our shipping statistics, are not now included. The particulars for the individual years recorded in the table are, consequently, not strictly comparable, but the errors involved in them are only small in magnitude. In *The Board of Trade Journal* for January 7, 1926, a rectification of the figures is provided, so as to show the shipping movements for the whole of the British Isles as they were shown prior to the constitution of the Irish Free State. Utilizing this correction, we get the following comparison:—

[In thousand net tons.]

	Average 1912-13.	1920.	1923.	1924.
Total entrances	79,169	55,718	87,949	83,238
„ clearances	79,464	57,343	87,744	84,577
„ entrances	100.0	70.4	111.1	105.1
„ clearances	100.0	72.2	110.4	106.4

While these figures adequately represent the movements of shipping, it must not be assumed that they equally represent movements of trade, for they include passenger traffic and ballast voyages, and in the case of vessels with cargo there can be no assurance that at the different dates they were loaded to the same extent of their capacity.

Ballast voyages.

Ballast voyages may, as already stated, be genuine ballast voyages in the popular acceptance of the term, or voyages of vessels which neither land nor load cargo in British ports but only call for bunkers, orders, or repairs, or to land or embark passengers. Having regard to the geographical position of the British Isles, it is natural that many Continental vessels fully loaded should call at British

ports for passengers or bunkers, and, consequently, it is not surprising that a much larger proportion of the entrances of foreign vessels are "ballast" entries than is the case with British vessels. With foreign vessels the ballast entries are largely "ballast" in the technical sense, whereas with British vessels they are probably in the main empty ships: the same is true of the clearances in ballast, except clearances from coal ports with bunkers only, and clearances on an inward voyage when an intermediate call is made at a foreign port. Liners, of course, always carry some cargo as well as passengers on both their outward and homeward journeys, but even with the tramp the ideal voyage is with cargoes both ways; a typical round trip used to be outwards with coal to Italy, in ballast to the Black Sea, and home with grain. Even in the happy pre-war days there was a good deal of ballast-voyaging to the Atlantic Coast of North America and to the River Plate for grain, and in the post-war days, with an overplus of world's shipping and a reduction in world's trade, much hunting has to be done for cargo. The constant complaint of the shipping papers during the past two years has been that whenever there was a report of fair rates being offered in any loading area all the unemployed shipping rushed there and brought the rates tumbling. The actual clearances of British tonnage in ballast in 1924 and 1925 were greater than the average ballast clearances of 1912-13 and constituted a little over 23 per cent. of the total British clearances instead of 14.9 per cent. This was a sensibly worse situation than in 1923, when the situation in the Ruhr alleviated somewhat the hardships of shipowners; then British ballast clearances were about 40 per cent. greater than in 1912-13 and formed 19.4 per cent. of the total British clearances. In the year 1920 ballast clearances of British vessels were nearly 31 per cent. of the total British clearances, a fact eloquent of the rush to bring home food and raw materials. The clearances of foreign ships in ballast were 51 per cent. more in 1924 than in 1912-13, and formed over 33 per cent. of the total foreign clearances instead of less than 23 per cent.; the proportion of ballast clearances was less in 1923 when coal cargoes were more abundant; in 1920 we have again empty ships being sent abroad for supplies.

Cargo voyages.

The movement of vessels with cargoes is more significant of activity in moving goods and passengers, the object of ballast voyages (other than those of ships calling for passengers and bunkers or to land passengers) being ancillary to cargo voyages. In 1920 delays due to vessels being out of position owing to their concentration on

special services during the war, to the need for re-conditioning them after war service, and to serious troubles in all ports, coupled with a universal shortage in goods, produced a great falling off in the cargo services of shipping. British ships, however, suffered less than foreign ships, so far as trade at British ports was concerned, British entrances with cargo falling off by 19.6 per cent. compared with the average of 1912-13 and foreign entrances by 31.3 per cent., and, while British clearances with cargo were reduced by 39.3 per cent., foreign clearances fell by one-half.

In the last three years there has been a progressive increase in the entrances of British ships with cargoes, entrances in 1925 being 9.1 per cent. greater than the average of 1912-13, while clearances were 4.1 per cent. less; clearances in 1925 and 1924 were practically the same and both were less than in 1923, when they were 1.7 per cent. above 1912-13 owing to the special circumstances of the coal trade. In the case of foreign ships, entrances with cargoes in 1925 were 9.6 per cent. above the average for 1912-13 and clearances were 20.2 per cent. less; entrances in 1925 were substantially less than in 1923 and 1924, and the same is true of clearances which in 1923, owing to coal, were 9 per cent. above the average of 1912-13. Summing up for the whole period, we find that the proportion of cargo trade held by British ships varied as follows :—

	Average 1912-13.	1920.	1923.	1924.	1925.
British entrances with cargo	Per cent. 66.5	Per cent. 69.9	Per cent. 63.3	Per cent. 64.4	Per cent. 66.4
„ clearances „ „	59.7	64.1	58.0	61.4	64.0

The last five years have been a period of unprecedented difficulty for the British shipping industry, and it is no small testimony to its efficiency that last year, in respect of entrances with cargo, it had practically got back to its pre-war position, while, as regards clearances with cargo, it held 64 per cent. of the shipping movement against less than 60 per cent. in 1912-13.

Voyages by nationalities.

Table III shows the entrances and clearances of ships with cargo and in ballast in 1924 and in 1913, distinguishing the vessels by leading nationalities. While the aggregate of entrances and clearances in 1924 was only 0.8 per cent. greater than the total in 1913 and the British share rose by 1.38 per cent., there were considerable changes in

the shipping carried on at British ports by different foreign nations. The German shipping movement was less by nearly 54 per cent. than in 1913: in 1920 entrances and clearances of German ships were only 604,000 net tons, a negligible quantity, but in 1922 they were 3,714,000 net tons, and the increase to 8,370,000 net tons in 1924 is a considerable achievement. Norwegian shipping experienced a loss of over 21 per cent. compared with 1913 and of about 10 per cent. compared with 1922. French entrances and clearances were greater by over 106 per cent. than in 1913 and by nearly 22 per cent. than in 1922. Entrances and clearances of United States shipping have fallen off by about 22 per cent. since 1922, but they are still four and a-fifth times their total in 1913. Dutch entrances and clearances were 51 per cent. greater than in 1913, but 3 per cent. less than in 1922. All these changes may be attributed to the direct or indirect effects of the war, supplemented, as in the case of France, by state support of national shipping.

The table brings out again clearly the importance of "ballast" voyages in the foreign record, and it is much to be regretted that no method, equally effective and economical, has yet been devised to enable a reliable record to be taken, separating the vessels really "in ballast" from those technically "in ballast." If this could be done it would be possible to discriminate between vessels coming here empty to load up with cargo, loaded vessels calling for bunkers only, and liners calling only to land or embark passengers.

The long-distance traffic.

Another point of great importance is that European vessels engaged in United Kingdom trade mainly ply between United Kingdom ports and European ports. If we exclude voyages in European waters and the Mediterranean basin, we can construct the following picture of the share which Continental and British vessels had in 1924 of the long-distance traffic.

Shipping movement in the United Kingdom ports from and to countries outside Europe and the Mediterranean basin in 1924.

[In thousand net tons.]

Nationality.	With cargo.		In ballast.		Entrances and clearances (extra-European)	
	Entrances	Clearances	Entrances	Clearances	Total	Proportion to total movement at British ports of shipping under each flag.
						Per cent
Dutch	925	715	423	471	2,534	26.3
French	454	255	101	403	1,243	13.3
Norwegian	538	296	69	651	1,554	16.7
German	508	154	456	737	1,855	22.2
Danish	149	157	37	233	576	9.5
Swedish	161	42	44	176	423	7.6
Italian	199	155	15	113	482	23.2
British	21,806	19,494	966	5,420	47,686	49.5

Four-fifths of the extra-European movement of Dutch vessels calling at British ports is with Eastern Asia and the Atlantic coasts of North and South America; about one-half of the similar movement of German vessels is with the Atlantic coast of North America; and half the Italian movement is with the Atlantic coast of South America. A large proportion of the ballast entrances and clearances of Dutch and German vessels is known to relate to liners. The shipping movement on the route between United Kingdom ports and the Atlantic coast of North America (Canada, Newfoundland, and United States) is so important that its distribution in 1924 is shown here:—

Shipping movement at United Kingdom ports in 1924 from and to ports on the Atlantic coast of North America.

[In thousand net tons.]

Nationality.	With cargo.		In ballast.		Total entrances and clearances
	Entrances	Clearances	Entrances	Clearances	
United States	2,447	1,304	104	1,245	5,100
German	233	23	230	428	914
Dutch	197	53	184	376	810
French	267	63	88	357	775
Norwegian	166	73	22	341	602
Danish	30	23	13	145	211
Swedish	47	3	22	89	161
Italian	15	24	7	69	115
Japanese	12	72	—	30	114
Other	44	12	164	314	534
Total foreign	3,458	1,650	834	3,394	9,336
British	9,349	8,486	590	2,778	21,203
Total	12,807	10,136	1,424	6,172	30,539

Shipping movement at United Kingdom ports in 1924 from and to ports on the Atlantic coast of North America—Contd.

[In percentages.]

Nationality.	With cargo.		In ballast		Total entrances and clearances.
	Entrances.	Clearances.	Entrances.	Clearances.	
United States	19.11	12.87	7.30	20.17	16.70
German	1.82	0.23	16.15	6.93	2.99
Dutch	1.54	0.52	12.92	6.09	2.65
French	2.08	0.62	6.18	5.78	2.54
Norwegian	1.30	0.72	1.55	5.53	1.97
Danish	0.23	0.23	0.91	2.35	0.69
Swedish	0.37	0.03	1.55	1.44	0.53
Italian	0.12	0.24	0.49	1.12	0.38
Japanese	0.09	0.71	—	0.49	0.37
Other	0.34	0.11	11.52	5.09	1.75
Total foreign	27.00	16.28	58.57	54.99	30.57
British	73.00	83.72	41.43	45.01	69.43
Total	100.00	100.00	100.00	100.00	100.00

The ballast entrances and clearances of United States, Dutch and German vessels on this route, as well as those of German, French and Dutch vessels shown in the preceding table, may be attributed in the main to the calls at British ports of vessels (liners or others) to land or embark passengers or to take bunkers. The Norwegian and, to a less extent, the Danish entrances and clearances relate to tramp vessels in search of cargo, and, at most, taking on board bunkers at British ports.

Distribution of shipping services by areas.

The Annual Statement of Navigation classifies shipping movement at British ports according as the vessels are entered from or cleared to certain geographical areas. The first of these areas, the Irish Free State, was constituted from April 1, 1923, and is omitted from present consideration. The others are :—1. *Northern Europe*, north of the Franco-Belgian frontier ; 2. *Western Europe*, from the Franco-Belgian to the Franco-Italian frontier, with Morocco, Algeria and Tunis ; 3. *Central and Eastern Mediterranean*, the rest of the Mediterranean-Black Sea basin ; 4. *West and South Africa* ; 5. *East Africa, Persian Gulf, and India*, including Ceylon ; 6. *Eastern Asia and*

Pacific Islands, east and north of Singapore; 7. *Australasia*, Australia, New Zealand, New Guinea; 8. *North America (Atlantic Coast)*, Canada, Newfoundland, United States, Bermudas; 9. *West Indies and Central America, Atlantic Coast*, from Mexico to Venezuela (both included); 10. *South America (Atlantic Coast)*; 11. *Central and South America (Pacific Coast)*; 12. *North America, Pacific Coast* of United States and Canada; 13. *Other Areas*, i.e. Deep-Sea Fisheries, Whale Fisheries, and Greenland. The countries included in each area are enumerated in the introductory notes to the Annual Statement, and the same classification is followed in the monthly record of entrances and clearances of vessels in cargo in the Accounts relating to Trade and Navigation of the United Kingdom.

Defects of the record.

Remembering that vessels entering at a British port with cargo from more than one port abroad are recorded as coming from the first port at which cargo for the United Kingdom was loaded, and that vessels clearing at a British port with cargo for more than one port abroad are recorded as clearing for the last port at which any such cargo is to be discharged, it is plain that the tabulation described above is not ideal. A vessel entering, for example, at a British port with cargo from Australia and Cape Town would be treated as coming from Australia, and one discharging cargo in India, China and Japan as clearing for Eastern Asia. The arrangement, however, is much preferable to that which prevailed before 1921, when entrances and clearances were tabulated according to the country of first loading or final discharge. The grouping of adjacent countries into areas eliminates a considerable amount, if not nearly the whole, of the unreality inherent in the old method of tabulation. The ideal method would be to class cargo voyages, at least, by definite routes, e.g. United Kingdom to Australia via the Suez Canal, United Kingdom to the River Plate calling at Vigo, Lisbon, Madeira, Santos, Rio de Janeiro, Monte Video, and Buenos Aires, and to treat all the trading along each route as a unit. Even the several voyages of tramps fall into fairly defined routes. *The Board of Trade Journal* for February 3, 1921, states that "some time ago a special investigation was made of the logs of British ships trading in 1913, for the purpose of ascertaining the distribution of shipping on different routes" (p. 116). These routes were over a hundred in number, but they could be combined into closely related groups, the degree of combination being determined by the contrary influences of economy and

the utility of the resulting information. The use of this particular method, however, involves a good deal of delay, since the analysis and tabulation cannot be completed until all the logs have come to hand, which occurs only following a considerable interval of time after the end of the year under examination.

A new tabulation.

Practically the same method can be adopted by the utilization of *Lloyd's Daily Index*, in which the daily position of all British and foreign ships is shown, with the exception of British coasters, British vessels trading between the United Kingdom and ports between the Skaw and the Loire, and certain continental vessels on West European and Mediterranean routes. A card could be made for each vessel, showing its name and tonnage, on which the whole of its voyaging throughout the year could be recorded, each call and departure being posted up immediately from the *Daily Index*. It would soon appear that a very large number of these vessels were on regular routes, so that the cards could be appropriately marked and their tabulation would be easy. More difficulty would arise in the case of "tramps," constantly shifting from one route to another, but it would be of a purely mechanical kind, easily reducible by machine methods. There were engaged in trading during some part of the year 1924, and remaining on the Register at the end of that year, 716 sailing vessels and 5,307 steam and motor vessels, but of these 707 sailing vessels and 1,901 steam and motor vessels were employed in the "Home Trade," i.e. "trading or going within the following limits, viz. the United Kingdom, the Isle of Man, the Irish Free State, the Channel Islands, and the Continent of Europe between the River Elbe and Brest (inclusive)," and out of these the vessels solely engaged in coasting trade between ports in the United Kingdom would not fall within the scope of the proposed tabulation. The number of ocean-going vessels over 1,000 tons net included in the above figures was 2,880, so that, probably, about 3,500 cards would be necessary, not an extravagant number. Besides the information as to tonnage on each route that could be obtained in this way, other useful matters could be simultaneously ascertained, such as steaming time and time spent in ports.

Similar information could also be tabulated from the same source as to foreign vessels, whether trading to British ports or not, and as far as they were trading to British ports it would have to be tabulated in order to maintain the completeness of the present

statistics. It is obvious that the details so collected would be of great value to the Admiralty, besides providing British shipowners with a statistical measure of the amount of foreign competition in shipping on the different routes. In order to make this scheme possible, however, some information would be needed supplementary to that in *Lloyd's Index*. A part of this additional information would be secured if, in the posting of each vessel, a symbol (obtained by means of a slight alteration in their message code) were used to show whether it had cargo, passengers, or mails for the United Kingdom or not, that is, whether it was technically "with cargo" or "in ballast" (technically or not). It might then have to be considered whether the present method of recording "ballast" voyages should be amended. Secondly, the entries in *Lloyd's Index* would need supplementing so as to include at least British and foreign vessels trading between the United Kingdom and ports between the Skaw and the Loire, which are at present excluded. Whether this new method should be substituted for the existing one depends on the possibility of securing this additional information, and on the opinion of the shipping world as to the greater utility of the information so obtained in comparison with some, possibly slight, increase of expense. It might prove desirable to carry out a tabulation such as has been described in supplement to the particulars now obtained, for the purpose of ascertaining periodically, but not continuously, the British and foreign tonnage engaged on particular routes, whether with cargo or in ballast.

Changes in shipping by areas since 1913.

The movement of British and foreign shipping at British ports in the years 1913, 1920, 1923, 1924 and 1925 is shown in Table IV, both for voyages "with cargo" and voyages "in ballast." The figures for 1925 are provisional. Since vessels which land neither passengers nor cargo at a United Kingdom port are recorded as coming in ballast from the last foreign port touched, and since vessels which embark neither passengers nor cargo at a United Kingdom port are recorded as leaving in ballast for the first foreign port to which they are bound, it is plain that such voyages must be recorded mainly with Continental ports and the record gives no indication of the ballast voyages in search of cargo. Further analysis of such voyages can yield nothing useful, and, for the rest, discussion will be confined to voyages with cargo.

For the purposes of comparing the movement of shipping over

the thirteen years' period, the following table has been prepared.—

Areas	Index-numbers, 1911 = 100 (British and foreign vessels with cargoes)			
	Tonnage entered		Tonnage cleared	
	1920	1925	1920	1925
1. Northern Europe	52.79	91.75	38.35	78.36
2. Western Europe and Mediterranean	79.93	88.43	81.69	84.61
3. Central and Eastern Mediterranean	57.16	82.62	36.17	63.64
4. West and South Africa	91.40	123.16	69.73	81.59
5. East Africa to India	71.73	125.87	76.37	104.58
6. Eastern Asia : Pacific Islands	136.62	184.32	82.70	119.81
7. Australasia	94.40	137.93	67.49	114.75
8. North America (Atlantic)	80.68	114.37	68.47	120.77
9. West Indies : Central America (Atlantic)	148.99	231.32	66.05	92.00
10. South America (Atlantic)	96.93	86.90	32.34	67.78
11. Central and South America (Pacific)	71.54	119.14	41.53	53.63
12. North America (Pacific)	95.17	273.29	54.25	172.17
13. Other areas	48.65	160.36	275.00	350.00
Total	74.37	106.23	54.15	85.56

Areas	British percentage of total.					
	Tonnage entered			Tonnage cleared		
	1913.	1920	1925	1913	1920	1925
1. Northern Europe	42.22	38.58	44.59	37.35	38.24	46.10
2. Western Europe and Mediterranean	58.14	68.39	63.63	53.76	51.34	57.94
3. Central and Eastern Mediterranean	70.95	73.60	64.83	55.43	66.54	47.53
4. West and South Africa	82.55	88.78	84.96	79.75	85.19	80.37
5. East Africa to India	97.26	97.77	95.25	92.95	98.07	96.65
6. Eastern Asia : Pacific Islands	65.01	64.24	57.94	58.48	60.29	59.46
7. Australasia	93.73	96.29	94.92	97.59	99.90	99.58
8. North America (Atlantic)	82.11	78.62	74.33	81.56	85.22	81.38
9. West Indies : Central America (Atlantic)	89.04	94.00	80.08	81.55	98.51	87.43
10. South America (Atlantic)	89.17	88.65	84.09	87.11	87.74	80.62
11. Central and South America (Pacific)	77.33	95.77	80.97	51.21	97.67	83.97
12. North America (Pacific)	71.02	28.36	53.43	75.94	38.26	71.51
13. Other areas	3.61	3.70	1.12	—	—	21.43
Total	65.82	69.90	66.37	59.13	64.08	64.02

Measured by the aggregate of British and foreign tonnage engaged on the various routes (which does not necessarily correspond with the weight or value of the cargo carried), the year 1920 shows a considerable dislocation due to the war, which the succeeding five years have in part repaired. Whether measured by entrances or by clearances with cargo, the three continental areas were still in 1925 well below the 1913 level, though making a sensible recovery from 1920. All the remaining areas show considerable advances on 1913, except South America (Atlantic Coast), which was behind even 1920; explanation of the South American position is found in the fact that our imports of wheat, oats, maize, flour, and linseed from Argentina, which aggregated 3,236,000 tons in 1913 and 3,463,000 tons in 1920, were only 1,675,000 tons in 1925. The very remarkable increases in the Eastern Asia, West Indies, and Pacific North America areas deserve notice; the last mentioned is, of course, due to the opening of the Panama Canal. In clearances with cargo there is again a general advance on 1920, but only the areas East Africa to India, Eastern Asia, Australasia, Atlantic North America, Pacific North America, and Deep Sea Fisheries show increases over 1913, while the West Indies area is only 8 per cent. behind its 1913 level. The heavy losses in the European and Atlantic South America areas may be attributed to the decline in our coal exports, a phenomenon so much discussed of late that it need not be enlarged on here; the same cause (exports of coal to Chile in 1913 about 589,000 tons; in 1925 about 100,000 tons) has probably produced the loss of 46·37 per cent. in the tonnage cleared with cargoes for Pacific South and Central America. The reduction of one-half in our exports of coal to the Canary Islands and to French and Portuguese West Africa accounts for most of the loss in outward shipping to West and South Africa.

British gains and losses.

With regard to the British share of the cargo voyages, we have not fared so well in entrances with cargo as in clearances. The British share of entrances with cargo was greater in 1925 than in 1913 only in the areas of Northern Europe, Western Europe, West and South Africa, Australasia, and Pacific South and Central America; but in clearances with cargo, increases were registered not only in those areas but in East Africa to India, Eastern Asia, West Indies, and Deep Sea Fisheries. Comparing these percentages with the absolute figures of British tonnage engaged, it appears that, as regards entrances with cargo and comparing 1925 with 1913, we have now a larger proportion and a smaller amount of tonnage in the areas of

Northern Europe and Western Europe; we have a larger proportion and a larger tonnage in the areas of West and South Africa, Australasia, and Pacific South and Central America; and a smaller proportion and a smaller amount of tonnage in the areas of the Central and Eastern Mediterranean, Atlantic South America, and Deep Sea Fisheries; while in the areas East Africa to India, Eastern Asia, Atlantic North America, West Indies, and Pacific North America, our loaded tonnage inwards has increased, but at a less rate than the foreign tonnage engaged on those routes. With regard to clearances with cargoes, we have now, compared with 1923, a smaller amount of tonnage engaged in the areas of Northern Europe, Western Europe, West and South Africa, West Indies, and Pacific Central and South America, but still have gained relatively to the foreign shipping on those routes, while in the Central and Eastern Mediterranean and Atlantic South America areas we have lost both absolutely and relatively. We have gained both absolutely and relatively in the areas East Africa to India, Eastern Asia, Australasia, and Deep Sea Fisheries; but while we have a larger tonnage clearing with cargo for Atlantic North America and Pacific North America, we lost relatively to the foreigner, in this case, no doubt, the United States Shipping Board; the relative loss in the Atlantic North America area was only 0.18 per cent., but in the Pacific North America area it was 4.43 per cent. Only in the areas of Northern Europe, Western Europe, Pacific North America, and Deep Sea Fisheries did we hold a larger percentage share of the clearances with cargo in 1925 than in 1920, and in entrances with cargo we had a smaller percentage share in 1925 than in 1920 in all areas except Northern Europe; these figures emphasize the exceptional character of the year 1920.

The seamen's strike, 1925.

A special note must be made of the British entrances with cargo from Australasia, which for the whole year 1925 were 7.01 per cent. greater than for the whole year 1924, while during the first nine months of 1925 they were 16.11 per cent. greater than in the corresponding period of 1924. The change was mainly due to the tie-up of British ships in Australian and New Zealand ports during the seamen's strike of August–October, 1925. This tie-up began to affect the arrivals of ships in British ports in October, and in the last three months of 1925 the entrances of British ships with cargo from Australasia were 428,000 net tons, or 19.09 per cent. less than in the corresponding period of 1924, while entrances of foreign ships with cargo (which were not affected by the strike) increased from 11,712 net tons to 14,542 net tons. The effects of the release are seen in

the entrances of British ships with cargo in January, 1926, amounting to about 283,000 net tons against 207,000 net tons in January, 1925, and of 8,600 net tons of foreign shipping against 3,500 net tons. Clearances of British ships with cargo were also affected in November and December, 1925, which showed a loss of about 72,000 net tons, but a slight recovery was effected in January of this year. It would be rash to assume that all the effects of the dislocation of shipping have been wiped out, and it should be noted that in the first nine months of 1925 as compared with the first nine months of 1924 there was a slight accentuation of foreign competition on this route, the foreign percentages of entrances with cargo at British ports rising from 3.44 per cent. to 5.51 per cent.: the increase was spread over a variety of nationalities.

• *The relative importance of the areas.*

Table V exhibits the relative importance of different geographical areas in 1913, 1920 and 1925 as measured by the shipping engaged in communication between them and the United Kingdom. Naturally, Northern and Western Europe and the Atlantic Coast of North America were, and remain, the most important for both the British and the foreign shipping engaged, but the Central and Eastern Mediterranean area is also of considerable importance for foreign ships clearing from British ports. As regards entrances with cargo, the three European areas have diminished in importance, falling from 53.52 per cent. to 45.34 per cent. of the whole, and this is true both for British and foreign shipping. All the other areas, except Atlantic South America, have gained, the share of Atlantic North America rising from 23.24 per cent. to 25.02 per cent.: so far as British shipping is concerned, Atlantic North America and Atlantic South America suffered a slight relative loss. With regard to clearances with cargo, Europe declined from 63.63 per cent. to 57.42 per cent., and West and South Africa and both coasts of South America suffered a loss in importance; the chief gain again was with Atlantic North America, from 13.45 per cent. to 18.99 per cent.; considering British shipping alone, Europe fell from 49.20 per cent. to 44.91 per cent., and Atlantic South America from 12.44 per cent. to 8.42 per cent., while Atlantic North America rose from 18.55 per cent. to 24.14 per cent.

Seasons in the North Atlantic trade.

The records of monthly entrances and clearances of all British and foreign vessels at British ports with cargo reveal some interesting periodicities of movement. Our imports being largely food and

raw materials, the crop-harvesting period naturally shows itself in the subsequent shipping movement ; for example, in the dominance of the first half of the year (except in bad crop years) in the entrances with cargo from South America (Atlantic Coast) and Australasia. Other climatic influences, such as the reduction of entrances from Northern Europe in the winter owing to the closing of the Baltic by ice, may also be discerned. Similar movements in the clearances of vessels with cargoes are less obvious, since our exports, being mainly manufactured goods, are only in a less degree subject to seasonal variations ; heavy woollens and light woollens, for example, have different seasons of maximum export, but the variation tends to be eliminated when other goods are taken into account. The essential regularity of the shipping service on some routes is well exemplified by the Atlantic North America area, where the cereal year August 1 to July 31, and the closing of the St. Lawrence in the months December to April, are the dominant factors. The following table and charts A and B give the necessary particulars.

North America (Atlantic Coast).

[In thousand net tons.]

Month.	Entrances with cargo from				Clearances with cargo to			
	1922-3	1923-4	1924-5	1925-6	1922-3	1923-4	1924-5	1925-6.
August	1,107	1,107	1,187	1,173	1,584	1,043	1,023	1,071
September	1,029	1,196	1,260	1,224	1,502	988	991	1,071
October	1,170	1,280	1,387	1,419	1,025	982	1,091	1,123
November	1,005	1,016	1,232	1,184	973	767	922	870
December	993	1,049	1,194	1,048	786	653	628	766
January	807	688	785	770	851	594	747	846
February	613	635	753	673	636	475	611	648
March	725	797	887	—	735	603	720	—
April	907	831	931	—	812	859	849	—
May	946	1,165	1,143	—	1,043	1,058	1,065	—
June	1,118	1,245	1,325	—	1,096	990	1,075	—
July	1,232	1,185	1,183	—	777	903	1,044	—

CHART A.

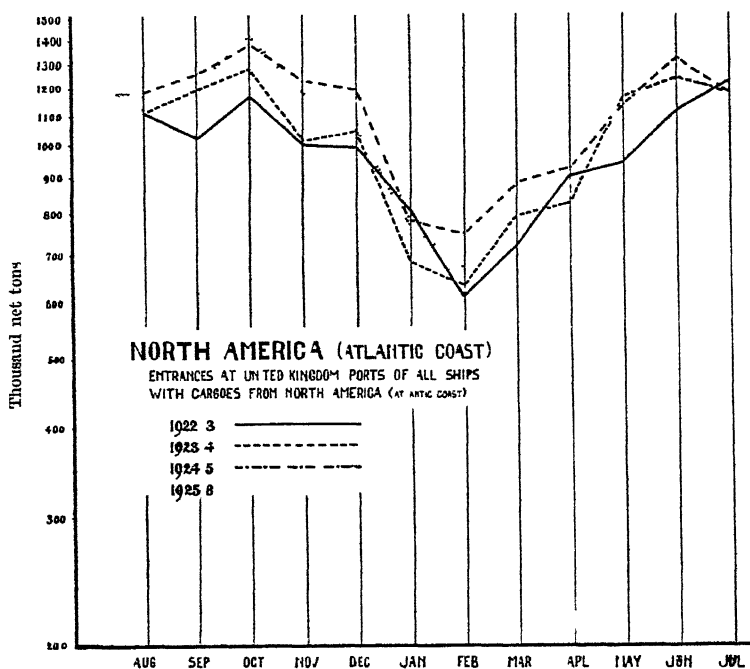
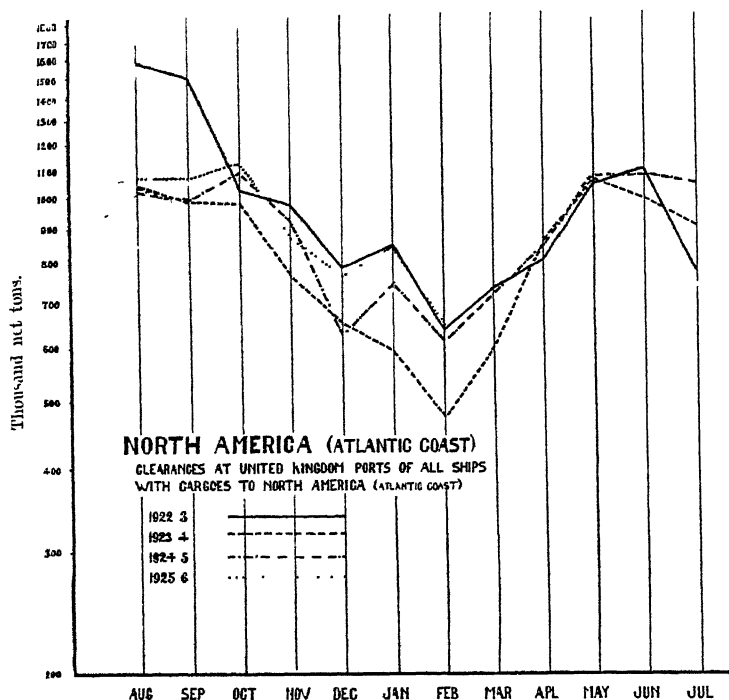


CHART B.



As the crops are shipped, arrivals in this country increase and reach a maximum in October; there is then a sharp fall, as the first needs of Europe have been satisfied, and as some passenger-liners are taken off the winter service, while Montreal and Quebec become inaccessible. Bottom having been reached in January-February, there is a rise as spring opens, and the passenger-liners that had been laid up or had been diverted to pleasure-cruising come back into service; and another peak is reached in June, which represents the top of the tourist season and the transport of the remainder of the old season's crop. Thereafter the service falls away by the withdrawal of tramps until the new cereal-shipping season opens in July in American ports, with arrivals here in late August and September. The curve of clearances with cargo is somewhat more irregular, but exhibits the same peaks in October and June and the same low points in February and July or August. In 1923 clearances were delayed by the dock-workers' strike in July and August. The close general similarity of the curves of outward and inward movement

with cargoes, suggests that the great bulk of the carrying is done by liners sailing regularly and spending but a short time in port. We may compare the table and charts for 1922-6 with the corresponding table, and charts C and D for 1912-14 which follow.—

North America (Atlantic Coast).

In thousand net tons.

Month.	Entrances with cargo from		Entrances with cargo to	
	1912-13	1913-14	1912-13	1913-14
August	937	1,031	906	854
September	959	1,087	849	830
October	1,031	1,103	810	910
November	887	948	745	750
December	968	1,002	612	617
January	746	771	630	636
February	726	681	574	626
March	876	849	671	710
April	846	819	714	722
May	965	905	842	931
June	995	1,187	818	919
July	1,078	1,081	882	929

CHART C.

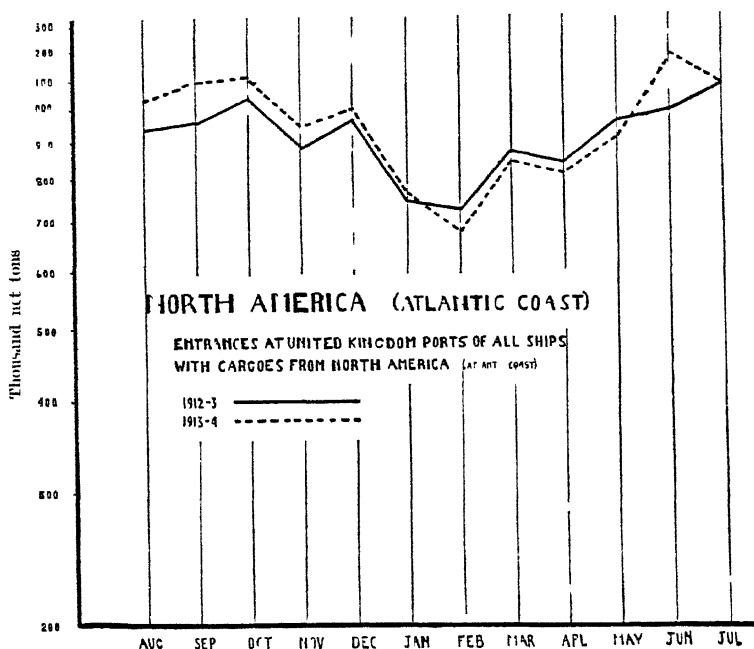
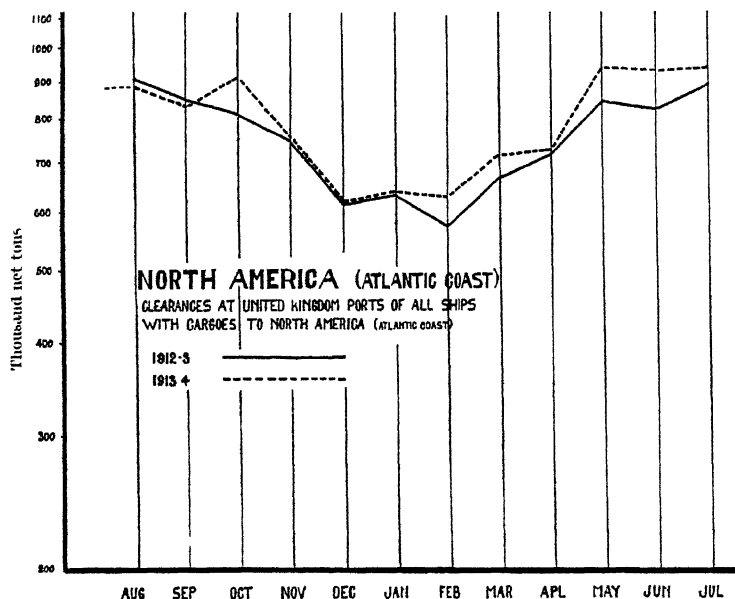


CHART D.



The figures in the table are not precisely accurate, estimates having to be made of trade at Pacific ports, but no great error is involved in any of them. The entrance curves show the same peaks in October and June (or July) and also subordinate peaks in December and March, where the 1922-6 curves only show shoulders. The clearance curves show much less conformity with the entrance curves than in 1922-6, suggesting that a smaller proportion of the vessels with cargo, inward and outward, were the same, that is, that there were more tramps. At the two periods the curves are of the same general form, indicating the common shaping influence of the crop movement, but the curves at the earlier period are shallower.

Winter and the Northern Europe trade

We may next select for examination the Northern Europe area :—

Northern Europe.

[In thousand net tons]

Month.	Entrances with cargo from			Clearances with cargo to		
	1923.	1924	1925	1923.	1924	1925.
January	986	930	1,127	1,651	1,678	1,456
February	823	774	972	1,704	1,508	1,279
March	890	817	1,055	2,396	1,441	1,410
April	946	943	1,018	2,170	1,485	1,302
May	1,040	1,178	1,077	2,177	1,554	1,400
June	1,245	1,235	1,328	2,134	1,643	1,354
July	1,290	1,554	1,378	2,056	1,786	1,532
August	1,262	1,473	1,399	2,242	1,812	1,315
September	1,256	1,461	1,378	2,258	1,812	1,510
October	1,297	1,404	1,351	2,472	1,805	1,666
November	1,177	1,117	1,241	2,285	1,679	1,550
December	1,174	1,301	1,103	1,992	1,606	1,480

It has not appeared necessary to reproduce the charts for this area, the table indicating quite clearly their general form. As regards entrances with cargo, the low point of the year is in February, even after allowing for the shortness of the month ; as the northern ports gradually open the shipping movement grows up till July or August ; a somewhat blunt top of the curve is formed from June to October, and then a rapid decline sets in. The curves of clearances with cargo for the three years show no similarity either to the entrance curves or among themselves, except that they tend to be at their highest from June to October. The curve for 1923 is deformed by the influence of the large coal export resulting from the Ruhr situation ; and, while 1924 shows a tendency to a definite seasonal movement, 1925 displays a peculiarly zigzag nature, influenced during part of the year by fears as to the coal situation. It may be left to the student to examine the shipping movement from and to the other areas in conjunction with the records of imports and exports.

Employment of shipping.

Particulars of the numbers and tonnage of ships employed during the year and of their crews constitute some important tables in the Annual Statement of Shipping. These particulars are given separately for steam and motor vessels and for all vessels, for vessels

Vessels on the Register of the United Kingdom, Isle of Man, and Channel Islands at the end of each year.

Class of vessel.	1924.				1923.				1922.			
	Sailing.		Steam.		Sailing.		Steam.		Sailing.		Steam.	
	No.	Thousand net tons.	No.	Thousand net tons.	No.	Thousand net tons.	No.	Thousand net tons.	No.	Thousand net tons.	No.	Thousand net tons.
Engaged in trading some time in year												
Home trade	707	55	1,901	180	733	59	2,026	570	878	79	2,022	501
Foreign trade	0	14	3,106	9,737	11	17	3,002	9,613	12	21	3,005	9,431
Both	—	—	3,106	226	—	—	188	138	1	—	260	230
Total	716	69	5,307	10,413	744	76	5,300	10,351	891	100	5,367	10,152
Fishing	341	11	3,004	195	351	11	3,033	100	353	11	3,015	196
Engaged in river trade or within partially smooth-water limits of the United Kingdom	3,615	341	1,932	133	3,677	327	1,934	135	3,627	325	1,908	145
Yachts	650	11	1,161	33	703	12	1,040	32	721	13	932	28
Unemployed sea traders	88	17	150	104	112	29	173	174	121	40	255	382
Inland navigation, or as tugs, dredgers, etc., abroad	106	48	297	80	126	60	314	101	122	54	327	93
Employed but no other information	—	—	3	30	1	—	2	—	2	—	21	47
No information as to employment	25	6	71	43	51	2	35	12	20	7	153	120
Employed by Government departments, local authorities, lightships, etc.	31	6	212	79	16	3	198	101	8	1	111	15
Broken up, etc., but still on Register	113	7	49	20	92	13	39	28	63	4	18	4
Fishing vessels not employed, or employed abroad	45	1	263	10	50	1	362	15	106	4	651	24
Hulks, etc.	101	14	16	13	65	16	8	13	74	8	7	9
Other vessels	6	1	48	2	4	1	21	2	6	1	274	2
Total	5,842	522	12,513	11,194	5,962	551	12,437*	11,160	6,184†	574	12,787	11,223

* Two vessels not accounted for.

† Ten vessels not accounted for.

‡ Five vessels in excess.

employed "sometime during the year." and for vessels employed during the year and remaining on the Register at the end of the year. The main tables distinguish vessels engaged in trading from those engaged in fishing (except fishing vessels registered only under Part IV of the Merchant Shipping Act, 1924), and a subordinate table (which has only been in existence since 1921) provides a classification of vessels registered but not included in the employment returns, since they were not engaged in sea-trading. The table on p. 484 gives an account of the vessels on the Register at the end of each of the three years 1922 to 1924; it should be noted that the particulars for 1922 include the Irish Free State as part of the United Kingdom, and that "employment in the Home Trade" means "trading or going within the following limits, viz., the United Kingdom, the Isle of Man, the Irish Free State, the Channel Islands, and the Continent of Europe between the River Elbe and Brest (inclusive)."

The number of vessels which are not "ships" for our purposes bears nearly as large a proportion to the total number on the Register as books which are "abiblia" bear to all books. More especially is this true of sailing vessels, which at the end of 1924 were less than 12 per cent. of the number and less than seven-tenths of 1 per cent. of the tonnage of all vessels then engaged in sea-trading, and the sailing vessels (which include dumb barges), were, moreover, practically all engaged in the "Home Trade." The Home Trade (including the mixed trade) engaged only 7.24 per cent. of the total tonnage employed some time during 1924 and remaining on the Register at the end of the year, but this small percentage is, of course, compensated by the frequency of the journeys made.

Voyages per ton employed.

It is tempting to try and bring these figures of employment of trading vessels into relation with the figures of entrances and clearances of British ships with cargo or in ballast, but there are considerable difficulties in the way. Obviously, the short-sea routes should be separated from the long-sea routes, but the "Home Trade," besides including coasting trade, cuts across the two areas of Northern Europe and Western Europe and takes a piece out of each. The class of vessels employed partly in the Home Trade and partly in the Foreign Trade offers further troubles, but a scrutiny of their tonnage suggests that in recent years at least they are mainly engaged on the short-sea routes. We may, therefore, include them with the Home Trade vessels and assign the two classes to trading with

Northern and Western Europe. As a first approximation we then get the following table :—

[In thousand net tons.]

Year.	Tonnage employed any time during year in			British entrances and clearances with cargo and in ballast.			Number of entrances and clearances per ton employed.		
	Coast- ing and short- sea trade.	Foreign trade.	Total.	North and West Europe.	Other areas.	Total.	North and West Europe	Other areas.	All areas.
1924....	790	10,165	10,955	44,468	51,845	96,313	56.3	5.1	8.8
1923 ...	805	10,003	10,808	47,450	49,643	97,093	58.9	5.0	9.0
1922	821	9,770	10,591	42,271	47,300	89,571	51.5	4.8	8.5
1920	723	9,862	10,585	26,528	40,695	67,223	36.7	4.1	6.4
1913	1,275	10,475	11,750	43,300	49,950	93,250	—	—	7.9

In 1913 the figures for vessels engaged partly in the Home Trade and partly in the Foreign Trade included a good number that would have been more properly classed as in the Foreign Trade, and, consequently, the number of entrances and clearances in that year per ton employed are calculated for all areas only.

The calculation of the number of entrances and clearances cannot be taken as accurate, for in the case of Northern and Western Europe more entrances and clearances are included, particularly in ballast, than belong to the ships in the Home and mixed trades, and at the same time the divisor is swollen by the tonnage in the purely coasting trade; similar, but smaller, errors inhere in the calculations for the long-sea routes. Nevertheless, certain points are clearly indicated. Compared with 1913 the influence of greater average speed has increased the number of voyages made, and the results of the long delays in port and the slow turn round of ships in 1920 are very patent. The active coal traffic of 1923 shows itself in an increased number of voyages compared with either 1924 or 1922, while the figures for 1924 show an improvement on two years earlier. It should be noted that the tendency to the relative greater importance of shipping services to the more distant areas, which has been discerned in other statistics, would reduce the average number of voyages performed.

Tonnage unemployed.

A note of warning has to be given as to the figures of unemployed vessels contained in Table 21 of the Annual Statement and summarized

on p. 484, which relate solely to those vessels which had no crews throughout the year, and are in no way comparable with the quarterly figures published by the Chamber of Shipping as to the British tonnage laid up in thirty-five leading United Kingdom ports for lack of freight. The Chamber of Shipping figures are given below :—

British tonnage laid up in United Kingdom ports.

[In thousand net tons]

On 1st of month.	1921.	1922	1923	1924.	1925.	1926.
January	—	1,180	672	606	470	393
April	—	734	506	391	377	—
July	1,651*	1,026	668	446	754	—
October	1,156*	752	727	308	557	—

* 25th of month.

July, 1921, represents the situation immediately after the coal stoppage, when about one-sixth of the tonnage of our sea-trading fleet was laid up. A general improvement from that date up to the middle of 1925 is indicated, and is confirmed by the figures in the Annual Statement table. Naturally, the larger classes of vessels are kept most in employment; thus, of the vessels on the register at the end of 1924, only 2 (25,000 net tons) over 8,000 net tons, 8 (47,000 net tons) of 5,000 net tons and under 8,000 net tons, and 19 (73,000 net tons) of 3,000 net tons and under 5,000 net tons were not included in the employment returns of the year, while 109 (174,000 net tons) of 1,000 net tons and under 3,000 net tons were not included. As the table on p. 484 shows, some of these vessels were not employed at any time during the year, for some there was no information, and others were in non-commercial employment.

Crews.

The employment tables also give some particulars of the crews of British vessels, distinguishing British subjects, lascars, and foreigners other than lascars: the aggregate figures are based on the first crews of employed vessels, and, consequently, do not represent the total number of individuals who may have spent some time at sea during the year. In 1913 there were employed on 8,639 vessels of 11,750,000 net tons in the aggregate, employed during some part of the year in trading, 256,260 persons; whereas, in 1924, there were similarly employed 234,317 persons on 6,292 vessels aggregating 10,955,000 net tons; in 1913 one person was engaged for every 45·85 net tons,

and in 1924 one person for every 46.75 net tons. This relative reduction of personnel is in part due to the disappearance of the sailing-ship, for while in 1913 there were 11,544 persons employed on sailing-ships engaged in sea-trading (or at the rate of one person per 40.76 net tons), in 1924 there were only 2,294 (or at the rate of one person per 32.50 net tons). Coming to steam-ships engaged in sea-trading, we can make the following comparison:—

Steam tonnage per person employed.

Classification of vessels.	Average tonnage per person employed.	
	1913.	1924
Under 100 tons net	Net tons. 6.03	Net tons. 7.93
If 100 and under 500 tons net	14.64	17.54
.. 500 .. 1,000 ..	29.18	29.34
.. 1,000 .. 2,000 ..	52.91	40.33
.. 2,000 .. 3,000 ..	64.52	62.24
.. 3,000 .. 5,000 ..	47.41	59.24
.. 5,000 .. 8,000 ..	38.26	44.86
.. 8,000 .. 12,000 ..	28.80	35.69
.. 12,000 net tons and over	32.29	30.72
All vessels	46.09	46.89

The economical ship.

In 1913 the class of ship of 2,250 net tons and under 2,500 net tons (averaging 2,375 net tons) was the most economical as regards manning, as it took only one person per 66.73 net tons or 36 persons per average vessel. In 1924 such a vessel would have had 37 persons employed, and the most economical type of vessel was the class of 2,750 net tons and under 3,000 net tons (averaging 2,875 net tons) which took one person per 64.43 net tons or an average crew of 44 or 45: in 1913 such a vessel would have had a crew of 45 or 46. Greater economy is shown in 1924 in all classes except those of vessels of 1,000 net tons and under 2,000 net tons, of 2,000 net tons and under 3,000 net tons, and of 12,000 net tons and over. The apparent lower economy of the largest classes of vessels is due to the fact that each such class includes a progressively greater number of passenger vessels with large steward staffs. The larger crews required in 1924 for steamers of 2,000 net tons and under 3,000 net tons are almost completely accounted for by the new class of wireless operatives, but this explanation is not sufficient for the class of 1,000 net tons and under 2,000 net tons. Much of the difference

between 1913 and 1924 is probably due to the effects of the Merchant Shipping Act of 1907 in at once reducing, in the case of new boats, the deductions for engine-room space in arriving at net tonnage and in re-classifying on this same basis all vessels after January 1, 1914. This re-measurement particularly affected passenger vessels with large engines and small gross tonnage. Another factor which would affect the comparison of 1924 with 1913 would be the proportion of passenger vessels with steward staffs in the two years.

The census of seamen.

A census of employed seamen was taken in 1891 and has been continued at quinquennial intervals, showing the numbers, nationalities, ratings, and ages of all persons employed on a specific date in the censal year (usually in the spring) in British ships. The first census was in some respects not on the same lines as later censuses, and may be neglected. No census was taken during the war, and the last census, of 1921, was rendered almost useless because it synchronized with the disorganization of shipping resulting from the coal troubles of that year. For inter-censal years we have only the employment returns of "first crews" to rely on, and it is of interest, therefore, to determine whether there is any relation between the numbers so ascertained and the particulars collected at the several censuses. This is done in Table VI for the four census years 1896, 1901, 1906, and 1911, and it will be at once seen from it that there is a remarkable steadiness in the proportion of British seamen in "first crews" of British trading vessels to those recorded at the censuses in those censal years, the proportion so recorded varying only from 79.2 to 79.5 per cent. and averaging 79.4 per cent. We can, therefore, conclude that there has been an increasing regularity of employment of British seamen, coincident with the development of liner service, and we can safely interpolate the census numbers of British seamen engaged on trading ships in non-censal years, but the same is not equally true of lascars and other foreigners. The percentage of lascars in first crews to those recorded at the corresponding censuses varied from 86.6 to 94.4 per cent., the average being 90.95 per cent. The percentage of other foreigners recorded at the respective censuses varied from 83.8 to 96.1 per cent., the average being 90.28 per cent. It is also worthy of note that while the proportions of lascars and other foreigners vary irregularly at successive censuses, the variations tend to correct each other, and the percentage of all persons engaged on British trading ships as recorded in first crews to those recorded at the census has slowly risen year by year.

Nationalities of crews.

Taking trading vessels only, we can get the following comparison as to the nationalities of crews :—

Nationality.	Number.			Comparison with 1896.		
	1896.	1911.	1924.	1896.	1911.	1924.
First crews :				Per cent.	Per cent.	Per cent.
British	157,293	171,929	167,078	100·00	109·30	106·22
Lascars	29,999	45,452	54,954	100·00	151·51	183·19
Other foreigners ..	32,754	29,892	12,285	100·00	91·26	37·51
Total	220,046	247,273	234,317	100·00	112·37	106·49
Census figures :						
British	125,009	136,580	—	100·00	109·26	—
Lascars	27,911	42,905	—	100·00	153·72	—
Other foreigners	27,446	28,729	—	100·00	104·67	—
Total	180,366	208,214	—	100·00	115·44	—

The great reduction in the employment of foreigners is largely due to the reduction in the number of foreign-going sailing-vessels on which foreigners were largely employed, and the increase in the number of lascars is due to the increase of our shipping services in tropical waters. In 1896 nearly one-half of the lascars recorded at the census, or 13,100, were employed on vessels entirely trading abroad ; in 1911 the number had risen to 16,571, but the proportion had fallen to nearly 39 per cent. The nationality of the foreign seamen recorded at the census as employed on British trading vessels has been as follows :—

Nationality.	1896.	1911.	1896.	1911.
			Per cent.	Per cent.
Sweden	5,219	3,585	19·01	12·48
Germany	5,167	4,891	18·83	17·02
Norway	3,669	2,131	13·37	7·42
United States	2,222	1,554	8·10	5·41
Russia	1,962	1,902	7·15	6·62
Denmark	1,518	1,288	5·53	4·48
France	824	572	3·00	1·99
Netherlands	1,070	1,324	3·90	4·61
Italy	885	1,369	3·22	4·77
Other countries or not stated	4,910	10,113	17·89	35·20
Total	27,446	28,729	100·00	100·00

The numbers and proportions of the various nationalities vary widely from census to census ; thus in 1906 there were 5,198 Swedes and 5,147 Germans, or 14.89 and 14.75 per cent. respectively. The reduction in the number of seamen recruited from the maritime nations like Sweden and Norway may be particularly associated with the reduction of the number of foreign-going sailing-vessels (on which the number of foreign sailors fell from 7,217 in 1896 to 1,362 in 1911), and the increase in the number of seamen of other foreign nationalities on British trading ships is due to employment in the engineers' and stewards' departments. The following table is instructive :—

Foreign countries	Sailors.		Firemen trimmers, etc		Stewards, etc	
	1896.	1911.	1896.	1911	1896	1911
Denmark	869	669	181	263	151	121
Germany	2,186	1,447	1,633	2,175	555	696
Netherlands	564	446	243	468	154	290
Norway	2,587	1,225	250	371	154	95
Russia	1,482	1,100	86	419	28	42
Sweden	3,471	1,819	710	924	180	125
United States	805	514	152	317	215	322
Maritime countries	11,964	7,220	3,255	4,937	1,437	1,691
Other countries	2,352	2,581	1,757	5,034	1,008	2,815
Total	14,316	9,801	5,012	9,971	2,445	4,506

Crews by departments.

The passing of the sailing-ship, the increasing size of steam-ships, and the construction of immense floating hotels as passenger vessels have their results in the relatively diminished personnel of the navigating department and the increased relative importance of the engine-room and stokehold staff and the catering staff. A comparison of 1896 and 1911 is as follows.

Grades.	1896.			
	British.	Lascars.	Foreigners.	Total.
Navigating department:				
Officers	22,920	—	692	23,612
Petty officers ..	6,540	1,940	2,657	11,137
Sailors	33,568	8,185	14,316	56,069
Apprentices and boys	5,786	—	213	5,999
Total	68,814	10,125	17,878	96,817
Engineers' department:				
Officers	12,248	—	247	12,495
Firemen, trimmers, etc.	21,208	12,249	5,012	38,469
Total	33,456	12,249	5,259	50,964
Catering department:				
Pursers	406	—	38	444
Stewards, cooks, etc.	16,346	5,537	2,426	24,309
Stewardesses	666	—	19	685
Total	17,418	5,537	2,483	25,438
Surgeons	304	—	5	309
Other men and rating not stated*	5,017	—	1,821	6,838
Total, all classes ..	125,009	27,911	27,446	180,366
Grades.	1911.			
	British.	Lascars.	Foreigners.	Total.
Navigating department:				
Officers	20,176	—	397	20,573
Petty officers ..	6,751	3,294	2,845	12,890
Sailors	27,827	11,259	9,801	48,887
Apprentices and boys ..	4,180	—	107	4,287
Total	58,934	14,553	13,150	86,637
Engineers' department:				
Officers	17,301	—	288	17,589
Firemen, trimmers, etc.	28,619	19,840	9,971	58,430
Total	45,920	19,840	10,259	76,019
Catering department:				
Pursers	898	—	99	997
Stewards, cooks, etc.	27,346	8,512	4,406	40,264
Stewardesses	1,169	—	100	1,269
Total	29,413	8,512	4,605	42,530
Surgeons	446	—	78	524
Other men and rating not stated*	1,867	—	637	2,504
Total, all classes	136,580	42,905	28,729	208,214

* Rating not stated, 4,023 in 1896; none in 1911.

Age-constitution of seamen.

The age-constitution of the persons employed in the British Mercantile Marine has been remarkably steady during the fifteen years 1896 to 1911, and even in the exceptional year 1921 the deviations from the normal were quite small. The analysis for 1911 of the ages of the British subjects (excluding lascars) engaged on trading-ships was as follows, the figures for the general occupied male population of England and Wales being also given for comparison :—

	Seamen.	Male population.
	Per cent.	Per cent.
Under 20 years of age	8.90	16.04
20 years of age and under 25 years	18.64	12.78
25 " " " 35 "	34.39	24.38
35 " " " 45 "	21.91	20.05
45 " " " 55 "	11.71	14.30
55 " " over	4.45	12.45
	100.00	100.00

Recruits to the seafaring occupations enter at a later age than recruits to occupations in general ; 53 per cent. of seafaring men are between 20 and 35 years of age as against a little more than 37 per cent. in all occupations ; in the age-group of males of 35 but under 45 years, seafaring occupations retain a slightly higher proportion than other occupations, but thereafter the proportion following the sea falls off very rapidly. About 30.8 per cent. of the masters and mates, about 24.8 per cent. of the petty officers, and about 17.0 per cent. of the engineers of British birth (British Isles, Dominions, etc.) on trading ships were 45 years old or over in 1911, while only 14.6 per cent. of the sailors, 12.6 per cent. of the firemen, etc., and 9.9 per cent. of the stewards, etc., were aged 45 years or more. Out of 24,110 firemen, etc., born in the British Isles, 3,466 were aged 45 years and upwards ; and 25.15 per cent. of those engaged in the coasting trade, 23.85 per cent. of those engaged in the Home Trade, and only 11.25 per cent. of those engaged in the Foreign Trade, were aged 45 years or more. It will also be observed that the proportion of engineers who leave the sea for shore jobs after the age of 45 is much greater than in the case of deck officers. Of British sailors, 19.3 per cent. of those engaged in the coasting trade, 19.3 per cent. of those engaged in the Home Trade, and 12.3 per cent. of those

engaged in the Foreign Trade, were aged 45 years and upwards. Both on deck and in the stokehold the Foreign Trade requires the younger men.

Trade at ports and coasting trade.

Elaborate tables (Nos. 5 and 6 in the Annual Statement of Navigation for 1924) deal with the Foreign Trade of the United Kingdom as recorded in the arrivals and departures at the individual ports, distinguishing sailing-vessels from steam- and motor-vessels, and vessels with cargo from those in ballast, and showing also the nationalities of the vessels and the areas with which they trade. Other tables deal with the coasting trade at the ports, and a third set shows the vessels on the registers of the various ports. These tables are of great local interest, but of more limited importance in the consideration of the shipping of the country as a whole.

The leading ports.

Adjusting for the changes resultant on the constitution of the Irish Free State, by omitting from the 1913 records the shipping movement at the ports of Southern Ireland, and by transferring the shipping movement between the United Kingdom and the Irish Free State in 1924 from "Foreign Trade" to "coasting trade," we are able to compare the years 1913 and 1924, though not with the same accuracy as is possible when dealing with the United Kingdom as a whole. Eleven leading ports (London, Liverpool, Southampton, Hull, Glasgow, Plymouth, Middlesbrough, Manchester, Bristol, Leith, and Belfast) engaged in general overseas trade, eleven leading coal-trade ports (Cardiff, Swansea, Newport, Port Talbot, Newcastle, Grimsby, Sunderland, Blyth, Hartlepool, Grangemouth, and Methil), and six passenger ports (Dover, Harwich, Cowes, Folkestone, Weymouth, and Newhaven) dealing mainly with Continental passenger traffic, since the chief ocean passenger ports are also important cargo ports, shared the shipping movement in the Foreign Trade as follows:—

	1913.		1924.	
	Arrivals.	Departures.	Arrivals.	Departures.
General ports...	54.16	49.21	60.66	55.77
Coal ports	29.61	36.23	25.48	31.34
Passenger ports	5.96	5.79	5.62	5.54
Other ports .. .	10.27	8.77	8.24	7.35
Total	100.00	100.00	100.00	100.00

On the whole, after adjusting for the Irish Free State, arrivals in the Foreign Trade increased in the eleven years by 6.99 per cent. and departures by 7.60 per cent., arrivals with cargo increased by 14.44 per cent., and departures with cargo decreased by 6.03 per cent., departures with cargo from the eleven coal ports alone falling off by 12.71 per cent. Comparing the eleven leading general ports in 1913 and 1924, we find the following changes :—

Increases (+) or decreases (—) in the shipping movement in the Foreign Trade at leading ports in 1924 compared with 1913 (excluding trade with Irish Free State).

	Arrivals.	Departures.
	Per cent.	Per cent.
London	+ 26.14	+ 30.75
Liverpool	+ 2.28	+ 3.83
Southampton	+ 36.22	+ 37.39
Hull	+ 15.73	+ 11.24
Glasgow	+ 6.86	+ 4.48
Plymouth	+ 15.80	+ 13.84
Middlesbrough	+ 3.41	+ 13.93
Manchester ..	+ 42.92	+ 57.51
Bristol ...	+ 49.71	+ 75.86
Leith. .	— 10.20	+ 0.33
Belfast ...	+ 166.15	+ 280.58

Relative changes at the ports.

Only one port shows a decrease, namely, Leith, in arrivals, while Belfast, Bristol, Manchester, Southampton, and London show very large increases. The increase in Belfast is due in part to increased traffic with the United States and to arrivals from or departures to other ports of the United Kingdom in the course of a foreign voyage (i.e. from or to North America), a feature of relatively small importance (except as regards departures) in 1913. This development has not been at the expense of Cork, and only to a very slight extent at the expense of Londonderry. In 1922 the total arrivals at Belfast were 616,000 net tons and the total departures 559,000 net tons; the great development took place in the following year. The growth of Manchester and Southampton, and (to some extent) of Bristol as a port for the Midlands, is at the expense of Liverpool, which shows a rate of growth so small as to suggest stagnation. The development of Plymouth as a port for landing mails and passengers is clearly indicated, and the development of London as a national emporium is shown by the fact that arrivals with cargo increased by 24.82 per cent., while departures with cargo were greater by only 4.97

per cent. The relative position of the coal ports in the two years is best measured by departures with cargoes. Departures with cargo from the two Forth ports declined by 17·83 per cent., those from the four South Wales ports decreased by 11·58 per cent., and those from the five North-East Coast ports by 16·07 per cent. Among the South Wales ports, Swansea and Newport gained at the expense of the others. Among the passengers ports, Dover shows a reduction of 778,000 net tons in arrivals and of 785,000 net tons in departures; in arrivals, the chief losses are 333,000 net tons of United States vessels, 471,000 net tons of Belgian vessels, 99,000 net tons of Dutch vessels, and 59,000 net tons of German vessels, while British, French, and other vessels show increases. In part there has been a reduction of cross-Channel voyages (*e.g.* in the number of daily services to and from Ostend), and in part a cessation of calls of liners proceeding from and to the United States in favour of calls at Southampton and Cowes. Cowes shows an increase from 17,000 net tons arrived and 24,000 net tons departed in 1913 to 940,000 net tons arrived and 960,000 net tons departed in 1924. This change began in 1923 and represents mainly the calls of liners proceeding between Northern Europe and North America, 344,000 net tons of the arrivals being German and 526,000 net tons being unspecified nationalities, mainly Dutch and Panama. These vessels, instead of going to Southampton and paying the heavier dues there, lie off the coast of the Isle of Wight and embark or disembark their passengers by tender; the growth of Cowes (which includes the Isle of Wight) as a port represents, therefore, a deduction from Southampton so far as it is not a transfer from Dover. An increase of 46·02 per cent. in departures from Harwich and a decrease of 45·11 per cent. in departures from Weymouth are other important changes.

The coasting trade.

In 1913 the coasting trade of the United Kingdom aggregated 65,274,000 net tons in arrivals and 65,111,000 net tons in departures, but, if the coasting trade at Southern Irish ports is eliminated, it is reduced to 61,080,000 net tons and 60,562,000 net tons respectively. In 1924 the recorded coasting trade of the United Kingdom was 47,206,000 net tons in arrivals and 47,250,000 net tons in departures; but if the present "Foreign Trade" with the Irish Free State is thrown back into the coasting trade, these figures are raised to 52,529,000 net tons and 52,412,000 net tons, respectively—a reduction of 13·73 per cent. on 1913. In 1922 the decrease from 1913 was 21·12 per cent., and part at least of the apparent increase since then is technical, arising out of the different methods of recording Irish

voyages. Part of what is recorded as coasting trade, moreover, is not genuine coastwise traffic, but the journeys of vessels which arrived in the foreign trade, discharged their cargoes, and proceeded to other ports for cargoes or bunkers. Both in 1913 and in 1924 about 5,000,000 net tons of foreign vessels are recorded as arriving and departing in ballast in the coasting trade, and practically all these may be confidently set down as properly connected with the foreign and not the coasting trade. With this correction the reduction in the coasting trade is increased to 15 per cent., and there is no doubt that it would be raised much higher if it were possible to eliminate the British foreign-trade vessels going empty coastwise. The competition of the railways, which became destructive during the war, has annexed much more of coastwise shipping trade than 15 per cent.

Total trade at leading ports.

An interesting study is provided by the comparison of the total trade, foreign and coasting (including that with the Irish Free State), at different ports, and some samples are given in Table IX. London shows itself as the largest port for both kinds of traffic, but while its arrivals with cargo are about 86 per cent. of the total arrivals, its departures with cargo are only 48 per cent. of the total departures. Departures in ballast in the foreign trade are about two and a-half times the arrivals in ballast, and only about one-third of the tonnage arriving with cargoes coastwise left with cargoes coastwise. About 2,145,000 net tons of shipping that arrived in the foreign trade departed coastwise in ballast to look for cargoes or bunkers. In Liverpool and Southampton a much closer equivalence in the arrival and departure of vessels with cargoes is preserved than in London, and only about 904,000 net tons of arrivals in the foreign trade at Liverpool departed coastwise in ballast, and practically none at Southampton. Plymouth presents the curious contradiction of a port whose shipping movement is about half that of Southampton, but is only one-fifteenth of the size in value of imports. The explanation is that the vessels arriving at Plymouth with cargoes are so classed in the main because they land mails, and as they in the main embark no cargo they are classed as departing in ballast when they proceed on the rest of their journey, even though in fact they have merchandise on board. Glasgow is an example of a port which is dominantly engaged in export; it receives ballast tonnage coastwise and sends it loaded into the foreign trade, the tonnage of departures with cargo being about a quarter greater than the tonnage of its arrivals with cargo. It is, nevertheless, a large receiving port, and

thus differs from a coal port like Newcastle, where the arrivals with cargoes are of moderate dimensions and most of the tonnage departed with cargoes (92 per cent. at Newcastle in 1924) previously arrived in ballast either coastwise or in the foreign trade. Such coal ports are the counterweight to ports like London. Hull, to conclude our examples, is a small edition of London, its departures in the foreign trade with cargoes are only 60 per cent. of its arrivals with cargo in the foreign trade: its departures in ballast (including departures to unload foreign cargo at another British port) in the foreign trade are about two and three-quarter times the arrivals in ballast; and some 509,000 net tons of arrivals in the foreign trade afterwards depart coastwise in ballast. Hull is also a large coal-exporting port, shipping 2,269,000 tons of coal cargoes in 1924, and has a considerable bunkering trade; it thus occupies an intermediate position between the general ports and the coal ports.

The British fishing fleet.

To complete our review of the Annual Statement, brief reference may be made to the fishing statistics contained therein. With a few exceptions, all fishing-boats are registered under Part IV of the Merchant Shipping Act, 1894, and the following table gives the particulars for 1913 and 1924, deduction being made of fishing-boats registered in 1913 at ports of what is now the Irish Free State:—

Fishing-boats belonging to the United Kingdom, Isle of Man and Channel Islands.

Class of boat	December 31, 1913.				December 31, 1924.			
	Sailing.		Steam.		Sailing		Steam.	
	No.	Net tons.	No.	Net tons.	No.	Net tons.	No.	Net tons.
15 net tons and over	2,920	99,623	3,498	177,539	655	20,536	4,068	229,370
Under 15 net tons and of or over 18 ft. keel	7,628	38,598	708	4,961	3,686	16,414	3,801	22,193
Under 18 ft. keel	4,509	7,302	—	—	4,754	6,996	—	—
Total	15,057	145,523	4,206	182,500	9,095	43,946	7,869	251,563

In 1913 there were in all 19,263 boats of an aggregate of 328,023 net tons; in 1924 there were 16,964 boats totalling 295,509 net tons, a reduction of 11·99 per cent. in number and 9·91 per cent. in

tonnage. Steam- and motor-boats (including converted sailing-boats) increased by 87·09 per cent. in number and by 37·84 per cent. in tonnage, while sailing-boats decreased by 39·60 per cent. in number and by 69·80 per cent. in tonnage.

The trend from sailing- to steam- or motor-boats is obvious. A considerable number of the boats included in the table above are also registered under Part I of the Merchant Shipping Act, 1894, for fishing and trading, and particulars of them are shown below :—

Fishing-boats registered under both Part I and Part IV of the Merchant Shipping Act, 1894.

Class of boat.	December 31, 1913.				December 31, 1924.			
	Sailing.		Steam.		Sailing.		Steam.	
	No.	Net tons.	No.	Net tons.	No.	Net tons.	No.	Net tons.
Under 50 net tons	863	26,853	1,838	56,728	359	10,443	1,629	54,448
50 net tons and under 100 net tons	129	7,328	1,449	114,846	24	1,359	1,069	82,741
100 net tons and over							560	66,599
Total ...	992	34,181	3,287	171,574	383	11,802	3,258	203,788

These larger boats are principally trawlers, and at the ports of Cardiff, Fleetwood, Grimsby, West Hartlepool, Hull, London, Middlesbrough, Milford, Swansea, and Aberdeen the average tonnage of all the steam vessels of 15 net tons or more (1,600 in all) average from about 74 to about 105 net tons at the individual ports.

The estimated number of men and boys employed in sea fishing in 1913 (excluding ports of Southern Ireland) was 84,353, of whom 69,670 were regular fishermen and 14,683 occasionally employed. In 1924 the total fell to 65,535, including 55,826 regular fishermen and 9,709 occasional. Trawling (except for shrimps) employed 24,739 persons in 1913 and 23,517 in 1924, the number of regular fishermen being 23,225 and 21,980 respectively. In other fisheries there were engaged 59,614 persons (46,445 regulars) in 1913 and 42,018 (33,846 regulars) in 1924. Included in the foregoing are the first crews of fishing-boats registered also under Part I of the Merchant Shipping Act, 1894, who numbered 35,797 in 1913 for the then United Kingdom, or probably about 35,400 after deducting vessels belonging to Southern Ireland, and 30,760 in 1924. It is

only to this latter class that the quinquennial Census of Seamen applies. These sea-going fishing-boats employed a very small number of foreigners, 884 in 1913 and 252 in 1924.

Gross shipping earnings.

Our investigations have, so far, been confined to official data ; it is now proposed to show what results can be obtained by the combination of official data as to movements of shipping, trade and passengers with unofficial information as to freight rates. An elaborate calculation was made in *The Board of Trade Journal* for February 3, 1921, from which it was concluded that the gross earnings of British shipping in 1920 were about £385 millions, an estimate very generally accepted at the time. Later calculations on a somewhat different basis were given in *The Board of Trade Journal* for January 21, 1926, and the official approval of the President of the Chamber of Shipping was given to the estimate that gross shipping earnings amounted to about £146 millions in 1923, to about £155 millions in 1924, and to about £138 millions in 1925. The object of the investigation which follows is to link up those four estimates, since, if they are reasonable, they should be mutually consistent.

Passenger earnings.

Gross earnings must first be divided into passenger earnings and freight earnings. *The Board of Trade Journal* of March 11, 1926, contains a report on the passenger movement from and to the United Kingdom in 1925, and from it and earlier annual reviews the following particulars are taken :—

[In thousands.]

Passenger movement between United Kingdom and	1920.	1923.	1924.	1925.
Europe	1,464	2,156	2,322	2,508
United States	263	263	205	226
Other Foreign Countries	34	40	42	46
British North America....	232	206	194	148
Australia ...	71	60	65	59
New Zealand		13	16	16
British South Africa		41	48	46
India and Ceylon	37	25	26	25
Rest of Empire....	29	26	29	30
Total	2,185	2,830	2,947	3,104

In addition there have to be included about 18,000 persons in 1923, 26,000 persons in 1924, and 39,000 persons in 1925, travelling from Irish Free State ports to the United States in British ships ; persons so travelling in 1920 were included in the United Kingdom

passenger movement. About 80 per cent. of the passenger movement is with Continental and Mediterranean countries, about 55 per cent. of the European movement in the last three years passing through Dover and Folkestone, about 25 per cent. through South Channel ports, and about 20 per cent. through other ports. As the first-class fare from Dover to Calais is 17s. 2d. and the third-class fare 13s. 8d., while the first-class fare from Southampton to Havre is 37s. 3d. and the third-class fare 27s. 3d., and in addition about one-third of the passengers travel by other than British boats, the shipping revenue does not run into many millions. With the ocean service it is quite different, for the fares, especially first-class, are undoubtedly high compared with pre-war rates. In 1925 about 27·6 per cent. of the ocean passengers were first-class, about 29·8 per cent. second-class, and about 42·6 per cent. third-class; the total numbers were 17·4 per cent. less than in 1920, but there was a slight increase in the first-class, the reduction falling on the others. The following passenger rates, based on the quotations in *Cook's Ocean Sailing List*, appear to represent fair averages in 1920 and 1925 :—

United Kingdom to	First-class.		Second-class.		Third-class.	
	1920.	1925.	1920.	1925.	1920.	1925.
	£	£	£	£	£	£
Canada	45	40	26	30	17	18½
United States	47	50	25	30	17	19
South Africa	66	70	47	50	27	28
Australia, via Suez	118	114	85	80	40	40
New Zealand	121	118	85	85	41	41
Bombay	62	80	48	54	—	30
Buenos Aires	81	78	55	40½	24	20
West Indies	44	35	33	25	—	—

Allowing for children and for about 15 to 20 per cent. of the passengers between the United Kingdom and the United States travelling on vessels not on the British Register, we may roughly estimate the gross earnings from passenger traffic at £27 millions in 1920, and at £26 millions in each of the years 1923, 1924, and 1925.

Freight earnings; method of calculation.

For the purpose of computing freight earnings, it is proposed to utilize the quotations given in *The Daily Freight Register*, which in its Annual Review at the end of December gives the average rates current during the preceding twelve months. The year 1920 has been selected as basis, partly because, as already stated, a detailed calculation of shipping earnings in that year was made by the Board

of Trade, and partly because 1920 is the base year for the Chamber of Shipping index-number of freights. The year 1913 also suggests itself as a possible basis, but since that year the changes in the proportion of shipping business done by tramps and in the size of vessels have been so great as to make it unsuitable. For the year 1920 some 130 freight rates are available, and for the last three years over 300, and the calculations based on them are embodied in Table X. The rates have been grouped according to their character and to the area within which the service fell. Thus, for Northern Europe all the coal freights outwards were grouped together and their arithmetical average was taken, as inspection showed that they varied with some regularity according to distance and changed usually in the same direction and in about the same degree. Similarly, the arithmetic average of the timber freights homewards was taken, for though little British shipping is engaged in this trade the timber rate serves as an indication of the movement of the rates which can be earned on general goods. The average rates for the year 1920 being represented by 100, the relative index-numbers for the later years were obtained by using the chain method arithmetically, new rates being in this way used when they were quoted. Finally, a combined rate for the whole of the British shipping serving Northern Europe was calculated by weighting the outward coal-rate index by the clearances of British ships with cargoes, and the homeward timber-rate index by the entrances of British ships with cargoes, and converting the resulting weighted rates into index-numbers.

Where several directional rates were used they were combined into one rate by weighting them according to the importance of the separate rates: thus, ore and timber rates homewards from Western Europe being both available, the entrances with cargo from that area were divided according to the weights of ore and timber imported from that area in the individual years; again, a grain and a space rate homewards from the Central and Eastern Mediterranean being available, these were weighted respectively by the weight of grain and the weight of cotton, cotton-seed, and cotton-seed cake imported from the area into the United Kingdom.

Twelve combined and weighted rates having been calculated in this way for the twelve areas into which shipping trading services are divided, a world rate was computed for each year by weighting the rate for each area by the percentage which the tonnage of British ships entered with cargo from the area and cleared with cargo to the area bore to the total tonnage of British ships with cargo entered from or cleared to all areas in that year.

The freight index-number.

The following table shows the final calculations :—

Area.	Cargo freight rates (1920 = 100).			Ballrauts and clearances of British vessels with cargoes.			Weighted cargo rates (1920 = 100).		
	1923.	1924.	1925.	1923.	1924.	1925.	1923.	1924.	1925.
1. Northern Europe	20.65	22.98	22.07	22.06	20.67	20.05	4.56	4.75	4.43
2. Western Europe and West Mediterranean	25.76	23.12	20.69	16.78	16.12	15.26	4.32	3.73	3.16
3. Central and East Mediterranean	21.37	23.40	21.30	4.44	4.91	5.11	0.95	1.15	1.09
4. West and South Africa	21.43	36.06	34.83	3.64	3.54	3.71	0.78	1.28	1.29
5. East Africa to India	25.80	27.28	24.88	8.10	8.12	8.20	2.09	2.22	2.04
6. Eastern Asia : Pacific Islands	28.43	27.46	23.69	2.90	3.00	3.02	0.82	0.82	0.72
7. Australasia	69.44	50.95	44.60	5.71	5.62	5.87	3.97	2.86	2.62
8. North America (Atlantic)	28.34	32.78	32.60	24.72	25.18	26.01	7.01	8.25	8.48
9. West Indies and Central America (Atlantic)	25.54	27.93	23.48	2.91	3.00	3.22	0.74	0.84	0.76
10. South America (Atlantic)	31.89	28.58	31.71	7.06	7.82	7.42	2.23	2.23	2.35
11. Central and South America (Pacific)	33.97	31.92	26.33	0.97	1.01	1.05	0.33	0.32	0.28
12. North America (Pacific)	33.02	34.65	31.07	0.71	1.01	1.08	0.23	0.35	0.34
	100.00	100.00	100.00	100.00	100.00	100.00	28.03	28.80	27.56

The weighted cargo rate compares as follows with the Chamber of Shipping index-number based on 25 rates :—

	1920.	1923.	1924.	1925.
Chamber of Shipping index-number	100·00	23·4	29·6	25·3
Weighted index-number . .	100·00	28·03	28·80	27·56

The Chamber of Shipping index-number was higher than the weighted index-number by 1·3 per cent. in 1923, and by 2·8 per cent. in 1924, and was lower by 8·2 per cent. in 1925 ; the differences are not excessive, except in the last year, and it may be only a coincidence that they have increased each year.

The loading index-number.

Deducting £27 millions of passenger earnings from the total earnings of £385 millions in 1920, the gross cargo earnings in that year were £358 millions ; and if the weighted index-number for the subsequent years were directly applicable, the cargo earnings for 1923 would be £100 millions, for 1924 they would be £103 millions, and for 1925 about £99 millions. That, however, would be to assume that ships were loaded to the same extent in each of the three years in question, and it is known that that was not the case. As imports and exports are not distinguished by the nationalities of the vessels in which they are carried, a close comparison of loading is impossible. Nevertheless, a rough and limiting comparison is possible by comparing the aggregate weight of cargoes carried with the total tonnage of all British and foreign ships entering at or clearing from United Kingdom ports with cargoes. The latter is known, but the former has to be estimated ; and, though there are many doubtful points in the calculation, the movement from year to year is probably indicated with sufficient accuracy. A more serious trouble is that the assumption is involved that British and foreign ships are loaded equally, whereas a large proportion of foreign vessels coming with rough cargoes such as timber, ore, and grain, or leaving with coal, are fully loaded, whereas British liners must sail on their scheduled dates, full or not full. The calculation will, therefore, give a maximum loading for British vessels, but this cannot be avoided. The relative data are :—

	1920.	1923.	1924.	1925.
Weight of cargo carried ... Million tons	90*	152*	139	125
Entrances and clearances with cargo Million net tons	80*	124*	121	118
Tons cargo per 100 net tons shipping	112.5	122.6	114.9	105.9
Index-number of loading	100.0	109.0	102.1	94.1

* Corrected for Irish Free State.

Provisional results.

After correcting the first calculation of cargo earnings by the loading index-number, we obtain the following further approximation to gross shipping earnings :—

[In million £'s.]

Provisional results.	1920.	1923.	1924.	1925.
Gross passenger earnings	27	26	26	26
Gross cargo earnings	358	109	105	93
Gross shipping earnings	385	135	131	119

The totals for the three years 1923, 1924, and 1925 are respectively less than the totals calculated by the Board of Trade for those years by £11 millions, £24 millions, and £19 millions. These differences may be accounted for (a) by the imperfection of the method of calculating the index-number of loading, (b) by the earnings of British ships on voyages entirely between foreign ports, and (c) by earnings in trade between the United Kingdom and the Irish Free State since April 1, 1923. The former is certainly a large amount, though relatively little is contributed net to the income of the United Kingdom, owing to the fact that nearly all the expenditure on the services is made abroad. The services of British vessels with the Irish Free State are recorded as follows :—

Trade with Irish Free State.	1923 (9 months).		1924.		1925.	
	No.	Thousand net tons.	No.	Thousand net tons.	No.	Thousand net tons.
Entered with cargoes	4,298	2,127	6,496	3,434	*	3,371
Cleared " "	8,867	2,745	12,619	4,327	*	4,266
Entered in ballast	5,229	1,021	6,850	1,314	*	*
Cleared " " ..	648	311	616	277	*	*

* Not yet published.

It will be observed that most of the ships are of small carrying capacity, and that much of the traffic is a one-way trade. Apparently our coal exports to the Irish Free State account for 21 to 25 per cent. of the shipping space clearing from our ports with cargoes for Free State ports. The average coal freight in 1923 was 7s. 8·68d., in 1924 it was 6s. 9·61d., and in 1925 it was 6s. 2·07d., while our exports were 1,485,425 tons in nine months of 1923, 2,471,856 tons in 1924, and 2,243,516 tons in 1925. The total on coal was thus about £574,000 in the nine months of 1923, about £840,000 in 1924, and about £676,000 in 1925. There have to be added the rates on other goods and the fares of 659,000 passengers between the United Kingdom and the Irish Free State in 1924 and 687,000 in 1925. The aggregate gross revenue from shipping with the Irish Free State cannot be much in excess of £2 millions a year. There remains for the revenue from services between foreign ports an amount varying between ten and twenty million pounds a year, a sum which seems reasonable.

The harmony of results.

We may, therefore, regard the estimates made by the Board of Trade for the gross earnings of British shipping in 1920, 1923, 1924, and 1925, as harmonious among themselves and as confirmed by the independent and more detailed investigation just made. The Board went on to estimate the expenditure of British ships in foreign ports, and concluded that the net national revenue from British shipping services was £345 millions in 1920, £120 millions in 1923, £130 millions in 1924, and £115 millions in 1925. This further calculation does not concern us here, as it does not depend on any of the data we have been examining. It should be added that neither the gross earnings nor the net national revenue from shipping is any indication of the profits of the shipping industry.

Objections to the freight index-number.

It may be objected that the rates used in the foregoing computations are mainly for the carriage of coal, timber, ore, grain, and other commodities usually transported in bulk cargoes, and that sufficient account has not been taken of the higher rates charged by liners for other goods. In reply it may be observed that the rates used do include some relatively high rates, on meat, wool, and sugar, whose omission would have materially reduced the average. Secondly, in 1925 nearly half the weight of our imports consisted of grain, ores, and timber, and over five-sevenths of our exports by weight was coal, so that special rates contribute only in a minor degree to

shipping income, and the amount to be added in respect of their excess over the rates on coarser produce is not great. Thirdly, if account has to be taken of these higher special rates, regard must be had also to the quantities of grain and other goods carried by liners at rates well below the cargo rates. The following statement of berth rates at New York is instructive, and it should be explained that the rates for wheat in the last three years were sometimes as low as 1s. a quarter and sometimes as high as 4s. :—

New York berth rates to Liverpool.

	1920.	1923.	1924.	1925.
Wheat per 480 lbs. shillings	13·834	2·01	2·707	2·302
Provisions per 100 lbs. cents	92·55	37·31	48·08	50·00
Flour per 140 lbs. „	71·83	16·50	19·29	19·06
Cotton per 100 lbs. „	155·91	32·00	42·02	45·29
Measurement goods per cubic foot cents	58·27	31·35	38·08	40·00

[1920 = 100.]

	1923.	1924.	1925.
Wheat per 480 lbs.	14·53	19·57	16·64
Provisions per 100 lbs.	40·31	51·95	54·02
Flour per 140 lbs.	22·97	26·86	26·53
Cotton per 100 lbs.	20·52	26·95	29·05
Measurement goods per cubic foot....	53·80	65·35	68·65

The weighted index-numbers for the North America (Atlantic) area were :—

	1920.	1923.	1924.	1925.
Wheat	100	26·80	31·88	26·80
Wheat and timber (weighted)....	100	28·34	32·78	32·60

The rate on wheat per quarter from Montreal to the United Kingdom in 1925 was 3s. 1 $\frac{3}{4}$ d., and that from Northern Range ports 3s. 1 $\frac{1}{2}$ d., or over 36 per cent. above the berth rate from New York. Only in provisions and measurement goods were the rates maintained on a higher level than the weighted index-number, while if the rate quoted for cotton can be taken as indicative of the movements of the cargo rate, which is highly probable, considering the quantity of cotton loaded in liners, that important commodity can also be brought

within the scope of the index-number. On the whole it does not appear that anything is to be gained by attempting to modify the North Atlantic index-number ; and if that is so with an area so important to our shipping, it is even more true for the areas which contribute much less to the whole. Further, the general time-charter rate fell from 25s. 3½d. in 1920 to 3s. 8d. in 1925, a fall to 14·5 per cent., while the European time-charter rate showed an even greater drop to 10·87 per cent., and all the other time-charter rates showed reductions greater than that indicated by the weighted index-number.

Freight rates 1913, 1920, and 1925.

It may be worth while to turn our attention for a moment to the movement of some of the freight rates. Since 1920 the average rate on coal to Northern Europe has declined to 13·16 per cent., that to Western Europe and Mediterranean to 16·53 per cent., and that to Central and Eastern Mediterranean to 19·27 per cent. ; the rate to West Africa has been better maintained at a reduction to 31·01 per cent., and the rate to South America, which tends to vary inversely with the homeward rate on grain, has decreased only to 39·73 per cent. The decline in coasting rates for coal was much less than the decline in rates to European ports :—Cardiff to London, down to 28·78 per cent., Tyne to London to 34·89 per cent., Cardiff to Dublin to 33 per cent. The decline in grain rates from the River Plate in 1925 was catastrophic, the average was 32·52 per cent. below the average for 1924 and 15·46 per cent. of that for 1920. The rate from North America was 26·80 per cent. of that for 1920, but the rate from Australia was maintained somewhat better at 30·04 per cent. A sharp contrast is provided in the movement of the rates for wool from South Africa and Australia, the former having declined by 62·5 per cent. and the latter by only 23·08 per cent. ; the competition of foreign ships is probably responsible for the considerable fall in the South African rate.

Before concluding, a glance may be taken at Table XI. The year 1920 was a year of abnormally high freight rates, and, consequently, Table XI has been drawn up to provide a comparison of some illustrative rates for 1913 and 1925. The first eight months of 1913 had seen rates maintained at the high level of 1912, but in the last four months the supply of ships overtook the demand for carrying space, and the situation was worsened by poor cotton and maize crops in the United States, so that a collapse in rates occurred. The comparison made is, therefore, not one of a slump year with a boom year, and the few cases in which there are recorded increases of any

magnitude, compared with the number in which there are actual decreases, reflect the financial predicament in which our shipping industry finds itself to-day.

Conclusion.

Our examination of shipping statistics has been prolonged, but not, I hope, to a length incommensurate with the importance of the subject. I have attempted to show what our official statistics reveal, and what further they can be made to demonstrate when used in conjunction with unofficial data. It is not pretended that the picture is complete or that it presents many aspects of novelty. The statistics themselves are improvable, but, even as they stand, more information can be extracted from them than I have been able to do within the compass of this paper. Shipowners are acquainted with the broad outlines of the facts of the industry as a whole and with the detailed particulars of their own individual businesses, but it is only through general statistics that we can obtain measures of tendencies. Science is measurement, and if more science is to be brought into industry, the data to be assembled and measured must be provided in greater quantity by those in whose hands they first accumulate. It is for you to say how far the account I have given is sufficient and accurate, and in so far as it may be lacking in these respects I trust that you will be equally vehement in pointing out the defects and in insisting that the authorities be given power to remedy them.

It remains for me gratefully to acknowledge the assistance which I have received from my colleagues in the Statistical Department of the Board of Trade. My thanks are due to Mr. Gibson and his staff for arduous work in computing the weight of imports and exports, to Mr. Priday for help on passenger earnings, to Mr. Selby for drawing the charts, and above all to Mr. Rose for unwearied assistance and advice over the whole paper—without his collaboration it could not have been completed in time for this session.

APPENDIX.

TABLE I.

Steam vessels on the Register at end of 1913.

[In thousand gross tons.]

Class of vessel.	Date of construction.					Total.
	Up to 1895.	1896- 1900.	1901- 1905.	1906- 1910.	1911- 1913.	
Under 1,500 tons gross	715	320	382	469	289	2,175
1,500 tons and under 3,000 tons gross... ..	914	414	475	406	233	2,442
3,000 tons and under 5,000 tons gross... ..	783	1,233	2,190	2,183	1,469	7,858
5,000 tons and under 8,000 tons gross... ..	322	857	821	703	1,083	3,786
8,000 tons and under 10,000 tons gross... ..	44	159	256	211	175	845
10,000 tons and under 12,000 tons gross... ..	20	107	66	139	273	605
12,000 tons and under 14,000 tons gross... ..	13	113	128	100	78	432
14,000 tons and over	—	46	121	160	213	540
Total	2,811	3,249	4,439	4,371	3,813	18,683

Percentages.

Under 1,500 tons gross	32.9	14.7	17.6	21.6	13.2	100.0
1,500 tons and under 3,000 tons gross... ..	37.4	17.0	19.5	16.6	9.5	100.0
3,000 tons and under 5,000 tons gross... ..	10.0	15.7	27.8	27.8	18.7	100.0
5,000 tons and under 8,000 tons gross... ..	8.5	22.6	21.7	18.6	28.6	100.0
8,000 tons and under 10,000 tons gross... ..	5.2	18.8	30.3	25.0	20.7	100.0
10,000 tons and under 12,000 tons gross... ..	3.3	17.7	10.9	23.0	45.1	100.0
12,000 tons and under 14,000 tons gross... ..	3.0	26.2	29.6	23.1	18.1	100.0
14,000 tons and over	—	8.5	22.4	29.6	39.5	100.0
Total	15.0	17.4	23.8	23.4	20.4	100.0

TABLE I—*Contd.**Steam vessels on the Register at end of 1924.*

[In thousand gross tons.]

Class of vessel.	Date of construction.					Total.
	Up to 1905.	1906- 1910.	1911- 1915.	1916- 1920.	1921- 1924.	
Under 1,500 tons gross	764	315	350	449	255	2,133
1,500 tons and under 3,000 tons gross....	490	194	212	340	466	1,702
3,000 tons and under 5,000 tons gross....	1,125	881	1,087	594	567	4,254
5,000 tons and under 8,000 tons gross....	818	405	1,255	2,542	1,544	6,564
8,000 tons and under 10,000 tons gross....	225	228	307	451	306	1,517
10,000 tons and under 12,000 tons gross	99	117	256	133	138	743
12,000 tons and under 14,000 tons gross	162	75	98	63	250	648
14,000 tons and over	145	138	373	187	479	1,322
Total	3,828	2,353	3,938	4,759	4,005	18,883

Percentages.

Under 1,500 tons gross	35.8	14.8	16.4	21.0	12.0	100.0
1,500 tons and under 3,000 tons gross....	28.8	11.3	12.5	20.0	27.4	100.0
3,000 tons and under 5,000 tons gross....	26.4	20.7	25.6	14.0	13.3	100.0
5,000 tons and under 8,000 tons gross....	12.5	6.2	19.1	38.7	23.5	100.0
8,000 tons and under 10,000 tons gross....	14.9	15.0	20.2	29.7	20.2	100.0
10,000 tons and under 12,000 tons gross	13.3	15.8	34.5	17.8	18.6	100.0
12,000 tons and under 14,000 tons gross	25.0	11.6	15.1	9.7	38.6	100.0
14,000 tons and over	11.0	10.4	28.2	14.2	36.2	100.0
Total	20.3	12.4	20.9	25.2	21.2	100.0

TABLE II.

Movement of shipping at British ports (excluding services to and from Irish Free State).

In thousand net tons]

Movement	Average 1912-13	1920	1923	1924	1925
British vessels					
Entered with cargoes	31 718	23,507	30,952	33,422	34,597
Entered in ballast	13,729	7,711	17,293	14,101	12,878
Total entrances	45,447	33,218	48,245	47,523	47,475
Cleared with cargoes	38,750	23,533	39,394	37,405	37,148
Cleared in ballast	6,761	10,472	9,454	11,385	11,244
Total clearances	45,511	34,005	48,848	48,790	48,392
Foreign vessels					
Entered with cargoes	15,988	10,986	17,982	18,479	17,525
Entered in ballast	17,734	11,514	20,867	16,096	14,333
Total entrances	33,722	22 500	38,849	34,575	31,858
Cleared with cargoes	26,178	13,193	28,526	23 554	20,879
Cleared in ballast	7,775	10,145	9 987	11,723	11,470
Total clearances	33,953	23,338	38,513	35,277	32,349
All vessels:					
Entered with cargoes	47,706	36,493	48,934	51,901	52,122
Entered in ballast	31,463	19,225	38,160	30,197	27,211
Total entrances	79,169	55,718	87,094	82,098	79,333
Cleared with cargoes	64,928	36,726	67,920	60,959	58,027
Cleared in ballast	14,536	20,617	19,441	23,108	22,714
Total clearances	79,464	57,343	87,361	84,067	80,741

TABLE II—*Contd.*

Movement of shipping at British ports (excluding services to and from Irish Free State).

[Percentages.]

Movement.	Average 1912-13.	1920.	1923.	1924.	1925.
British vessels :					
Entered with cargoes	69.8	76.8	64.2	70.3	72.9
Entered in ballast	30.2	23.2	35.8	29.7	27.1
Total entrances	100.0	100.0	100.0	100.0	100.0
Cleared with cargoes	85.1	69.2	80.6	76.7	76.8
Cleared in ballast	14.9	30.8	19.4	23.3	23.2
Total clearances	100.0	100.0	100.0	100.0	100.0
Foreign vessels :					
Entered with cargoes ..	47.4	48.8	46.3	53.4	55.0
Entered in ballast	52.6	51.2	53.7	46.6	45.0
Total entrances ..	100.0	100.0	100.0	100.0	100.0
Cleared with cargoes ..	77.1	56.5	74.1	66.8	64.5
Cleared in ballast	22.9	43.5	25.9	33.2	35.5
Total clearances ..	100.0	100.0	100.0	100.0	100.0
All vessels :					
Entered with cargoes ..	60.3	65.5	56.2	63.2	65.7
Entered in ballast	39.7	34.5	43.8	36.8	34.3
Total entrances	100.0	100.0	100.0	100.0	100.0
Cleared with cargoes ..	81.7	64.0	77.7	72.5	71.9
Cleared in ballast	18.3	36.0	22.3	27.5	28.1
Total clearances ...	100.0	100.0	100.0	100.0	100.0
Entrances with cargo :					
British	66.5	69.9	63.3	64.4	66.4
Foreign	33.5	30.1	36.7	35.6	33.6
Total	100.0	100.0	100.0	100.0	100.0
Clearances with cargo :					
British	59.7	64.1	58.0	61.4	64.0
Foreign	40.3	35.9	42.0	38.6	36.0
Total	100.0	100.0	100.0	100.0	100.0

TABLE III.

Shipping movement at British ports in 1913.

[In thousand net tons.]

Nationality.	With cargo.		In ballast.		Total entrances and clear- ances.
	Entrances.	Clear- ances.	Entrances.	Clear- ances.	
German.....	3,166	5,730	5,908	3,358	18,162
Norwegian.....	3,285	4,683	2,599	1,232	11,799
Swedish.....	1,891	3,016	1,509	440	6,856
Dutch.....	1,702	2,536	1,467	681	6,386
Danish.....	1,161	2,613	1,989	558	6,321
French.....	999	1,975	1,250	300	4,524
Spanish.....	1,060	1,694	703	108	3,565
Belgian.....	1,369	957	199	604	3,129
Greek.....	221	1,072	778	19	2,090
Italian.....	122	955	789	35	1,901
United States.....	724	370	93	468	1,655
Japanese.....	140	282	276	130	828
Other.....	932	1,836	1,214	362	4,344
Total foreign.....	16,772	27,719	18,774	8,295	71,560
British.....	32,292	40,101	14,311	6,546	93,250
Total.....	49,064	67,820	33,085	14,841	164,810

Percentages.

German.....	6.45	8.45	17.86	22.63	11.02
Norwegian.....	6.70	6.90	7.86	8.30	7.16
Swedish.....	3.85	4.45	4.56	2.96	4.16
Dutch.....	3.47	3.74	4.43	4.59	3.87
Danish.....	2.37	3.85	6.01	3.76	3.84
French.....	2.03	2.91	3.78	2.02	2.75
Spanish.....	2.16	2.50	2.12	0.73	2.16
Belgian.....	2.79	1.41	0.60	4.07	1.90
Greek.....	0.45	1.58	2.35	0.13	1.27
Italian.....	0.25	1.41	2.39	0.23	1.15
United States.....	1.48	0.54	0.28	3.15	1.00
Japanese.....	0.28	0.42	0.83	0.88	0.50
Other.....	1.90	2.71	3.67	2.44	2.64
Total foreign.....	34.18	40.87	56.74	55.89	43.42
British.....	65.82	59.13	43.26	44.11	56.58
Total.....	100.00	100.00	100.00	100.00	100.00

TABLE III—*Contd.*

Shipping movement at British ports in 1924 (excluding trade with Irish Free State).

[In thousand net tons.]

Nationality.	With cargo.		In ballast.		Total entrances and clearances.
	Entrances.	Clearances.	Entrances.	Clearances.	
Dutch	2,424	2,946	2,368	1,906	9,644
French	1,636	3,666	3,003	1,006	9,311
Norwegian	2,563	3,045	2,035	1,656	9,299
German	1,920	2,294	2,233	1,923	8,370
United States	2,747	1,361	748	2,097	6,953
Danish	1,489	2,335	1,529	698	6,051
Swedish....	1,686	2,039	1,047	768	5,540
Spanish....	959	1,383	555	182	3,079
Belgian	979	1,161	314	143	2,597
Italian ...	403	830	559	289	2,081
Greek ...	418	828	473	134	1,853
Japanese	458	476	347	361	1,642
Other	797	1,190	885	560	3,432
Total foreign	18,479	23,554	16,096	11,723	69,852
British	33,423	37,405	14,101	11,385	96,314
Total	51,902	60,959	30,197	23,108	166,166

Percentages.

Dutch	4.67	4.83	7.84	8.25	5.80
French	3.15	6.01	9.94	4.35	5.60
Norwegian	4.93	5.00	6.74	7.17	5.60
German	3.70	3.76	7.39	8.32	5.04
United States	5.29	2.23	2.48	9.08	4.19
Danish	2.87	3.83	5.06	3.02	3.64
Swedish....	3.25	3.35	3.47	3.32	3.33
Spanish	1.85	2.27	1.84	0.79	1.85
Belgian	1.89	1.91	1.04	0.62	1.56
Italian	0.78	1.36	1.85	1.25	1.25
Greek	0.80	1.36	1.57	0.58	1.12
Japanese	0.88	0.78	1.15	1.56	0.99
Other	1.54	1.95	2.93	2.42	2.07
Total foreign	35.60	38.64	53.30	50.73	42.04
British	64.40	61.36	46.70	49.27	57.96
Total ...	100.00	100.00	100.00	100.00	100.00

TABLE IV.

Movement of shipping at United Kingdom ports (excluding services from Irish Free State).

ENTERED WITH CARGOES.

[In thousand net tons.]

Areas from.	British.				
	1913	1920.	1923	1924.	1925.
1. Northern Europe	6,635	3,201	5,274	5,948	6,428
2. Western Europe and Mediterranean	5,030	4,729	4,438	4,819	4,869
3. Central and Eastern Mediterranean	1,343	797	800	848	1,014
4. West and South Africa	998	981	1,127	1,084	1,265
5. East Africa to India	2,553	1,841	3,122	3,176	3,147
6. Eastern Asia, Pacific Islands	680	918	1,073	1,069	1,117
7. Australasia	1,658	1,608	2,098	2,155	2,316
8. North America (Atlantic)	9,363	7,233	8,723	9,349	9,694
9. West Indies, Central America (Atlantic)	796	1,252	1,430	1,535	1,656
10. South America (Atlantic)	2,675	2,578	2,249	2,588	2,192
11. Central and South America (Pacific)	307	272	302	349	383
12. North America (Pacific)	250	95	316	501	514
13. Other areas	4	2	—	1	2
Total	32,292	25,507	30,952	33,422	34,597

Areas from.	Foreign.				
	1913.	1920	1923.	1924.	1925.
1. Northern Europe	9,079	5,095	8,112	8,239	7,989
2. Western Europe and Mediterranean	3,621	2,186	3,592	3,272	2,781
3. Central and Eastern Mediterranean	550	285	504	548	550
4. West and South Africa	211	124	238	230	224
5. East Africa to India	72	42	201	222	157
6. Eastern Asia, Pacific Islands	366	511	671	778	811
7. Australasia	111	62	43	69	124
8. North America (Atlantic)	2,040	1,967	3,274	3,458	3,348
9. West Indies, Central America (Atlantic)	98	80	258	333	412
10. South America (Atlantic)	325	330	552	561	415
11. Central and South America (Pacific)	90	12	57	108	90
12. North America (Pacific)	102	240	345	520	448
13. Other areas	107	52	135	142	176
Total	16,772	10,986	17,982	18,480	17,525

TABLE IV—*Contd.*

Movement of shipping at United Kingdom ports (excluding services to Irish Free State).

CLEARED WITH CARGOES.
[In thousand net tons.]

Areas to.	British.				
	1913.	1920.	1923.	1924.	1925.
1. Northern Europe	8,225	3,229	10,242	8,690	7,955
2. Western Europe and Mediterranean	6,663	5,198	7,362	6,592	6,076
3. Central and Eastern Mediterranean	4,841	2,102	2,321	2,630	2,651
4. West and South Africa ..	1,698	1,265	1,434	1,425	1,396
5. East Africa to India ..	2,518	2,029	2,579	2,581	2,738
6. Eastern Asia, Pacific Islands	862	735	965	1,058	1,050
7. Australasia	1,621	1,119	1,921	1,823	1,898
8. North America (Atlantic)	7,440	5,323	8,667	8,486	8,966
9. West Indies, Central America (Atlantic)	663	529	619	587	654
10. South America (Atlantic)	4,986	1,624	2,716	2,957	3,128
11. Central and South America (Pacific)	423	335	382	363	372
12. North America (Pacific)	161	44	180	212	261
13. Other areas	—	—	6	1	3
Total	40,101	23,532	39,394	37,405	37,148

Areas to.	Foreign.				
	1913.	1920.	1923.	1924.	1925.
1. Northern Europe	13,794	5,216	15,295	11,419	9,299
2. Western Europe and Mediterranean	5,730	4,926	6,193	5,358	4,410
3. Central and Eastern Mediterranean	3,892	1,057	3,082	2,757	2,927
4. West and South Africa ..	431	220	320	315	341
5. East Africa to India	191	40	91	106	95
6. Eastern Asia, Pacific Islands	612	484	686	709	716
7. Australasia	40	2	10	7	8
8. North America (Atlantic)	1,682	923	1,715	1,650	2,051
9. West Indies, Central America (Atlantic)	150	8	60	115	94
10. South America (Atlantic)	738	227	873	921	752
11. Central and South America (Pacific)	403	8	42	48	71
12. North America (Pacific)	51	71	122	111	104
13. Other areas	4	11	37	38	11
Total	27,718	13,193	28,526	23,554	20,879

TABLE IV—Contd.

Movement of shipping at United Kingdom ports (excluding services from Irish Free State).

ENTERED IN BALLAST.

[In thousand net tons.]

Areas from	British.				
	1913.	1920.	1923.	1924.	1925.
1. Northern Europe	9,335	3,625	10,391	8,516	7,780
2. Western Europe and Mediterranean	3,820	3,144	5,082	4,191	3,309
3. Central and Eastern Mediterranean	643	238	501	428	650
4. West and South Africa	41	13	46	14	67
5. East Africa to India	85	118	175	183	209
6. Eastern Asia, Pacific Islands	36	47	20	27	22
7. Australasia	36	18	92	9	72
8. North America (Atlantic)	125	359	895	590	589
9. West Indies, Central America (Atlantic)	7	10	27	20	15
10. South America (Atlantic)	114	128	49	112	154
11. Central and South America (Pacific)	40	10	11	10	10
12. North America (Pacific)	7	—	—	—	$\frac{1}{2}$
13. Other areas	21	1	4	1	1
Total	14,310	7,711	17,293	14,101	12,882

Areas from.	Foreign.				
	1913	1920.	1923.	1924.	1925.
1. Northern Europe	11,953	5,719	12,720	9,463	8,452
2. Western Europe and Mediterranean	4,006	4,631	5,850	4,618	3,635
3. Central and Eastern Mediterranean	1,280	261	1,100	563	521
4. West and South Africa	97	25	58	37	51
5. East Africa to India	24	16	63	60	91
6. Eastern Asia, Pacific Islands	134	43	61	209	215
7. Australasia	126	19	10	13	30
8. North America (Atlantic)	547	529	759	834	996
9. West Indies, Central America (Atlantic)	45	15	97	95	112
10. South America (Atlantic)	315	213	89	108	127
11. Central and South America (Pacific)	189	30	12	23	24
12. North America (Pacific)	25	4	8	4	—
13. Other areas	33	9	41	69	75
Total	18,774	11,514	20,868	16,096	14,329

TABLE IV—*Contd.*

Movement of shipping at United Kingdom ports (excluding services to Irish Free State).

CLEARED IN BALLAST.

[In thousand net tons.]

Areas to.	British.				
	1913.	1920.	1923.	1924.	1925.
1. Northern Europe	2,599	2,161	3,277	4,110	4,089
2. Western Europe and Mediterranean	994	1,241	1,384	1,603	2,121
3. Central and Eastern Mediterranean	328	159	145	252	230
4. West and South Africa ...	31	72	78	87	122
5. East Africa to India ...	61	176	638	712	814
6. Eastern Asia, Pacific Islands	23	28	60	50	79
7. Australasia	16	123	162	84	100
8. North America (Atlantic)	2,052	5,133	2,248	2,779	2,217
9. West Indies, Central America (Atlantic)	288	664	849	894	790
10. South America (Atlantic)	145	637	410	644	450
11. Central and South America (Pacific)	1	18	29	29	27
12. North America (Pacific) ...	4	58	167	141	199
13. Other areas	3	3	7	—	7
Total	6,545	10,473	9,454	11,385	11,245

Areas to.	Foreign.				
	1913.	1920.	1923.	1924.	1925.
1. Northern Europe	5,899	3,414	3,842	5,030	5,314
2. Western Europe and Mediterranean	753	1,170	2,295	2,016	2,024
3. Central and Eastern Mediterranean	213	132	131	134	114
4. West and South Africa ...	121	193	188	208	197
5. East Africa to India ...	91	69	64	107	107
6. Eastern Asia, Pacific Islands	37	85	55	41	32
7. Australasia	64	17	20	27	22
8. North America (Atlantic)	794	4,326	2,652	3,394	3,023
9. West Indies, Central America (Atlantic)	65	185	234	253	237
10. South America (Atlantic)	113	392	148	201	132
11. Central and South America (Pacific)	8	28	15	25	11
12. North America (Pacific) ...	7	21	72	54	73
13. Other areas	131	112	272	232	192
Total	8,296	10,144	9,988	11,722	11,478

TABLE VI.

Census of seamen.

On sea-going vessels registered under Part I of the Merchant Shipping Act, 1894.	Employed on			
	March 25, 1896.	March 31, 1901.	April 4, 1906.	April 3, 1911.
On trading vessels :				
British	125,009	120,412	128,077	136,580
Lascars	27,911	33,610	38,425	42,905
Foreigners other than lascars	27,446	32,614	34,906	28,729
Total	180,366	186,636	201,408	208,214
On fishing vessels :				
British	18,827	18,874	22,366	24,155
Foreigners	309	628	766	899
Total	19,136	19,502	23,132	25,054
Grand total	199,502	206,138	224,540	233,268

Employment returns : first crews.

On sea-going vessels registered under Part I of the Merchant Shipping Act, 1894.	Employed in			
	1896.	1901.	1906.	1911.
On trading vessels :				
British	157,293	151,376	161,637	171,929
Lascars	29,999	37,431	44,367	45,452
Foreigners other than lascars	32,754	37,174	37,326	29,892
Total	220,046	225,981	243,330	247,273
On fishing vessels :				
British	21,701	21,536	26,703	33,136
Foreigners	292	456	758	891
Total	21,993	21,992	27,461	34,027
Grand total	242,039	247,973	270,791	281,300

TABLE VI—*Contd.**Percentage of first crews recorded at census.*

On sea-going vessels registered under Part I of the Merchant Shipping Act, 1894.	Employed in			
	1896.	1901	1906.	1911.
On trading vessels :				
British	79.5	79.5	79.2	79.4
Lascars	93.0	89.8	86.6	94.4
Foreigners other than lascars	83.8	87.7	93.5	96.1
Total	82.0	82.6	82.8	84.2
On fishing vessels :				
British	86.8	87.6	83.8	72.9
Foreigners	—	—	—	—
Total	87.0	88.7	84.2	73.6
Grand total	82.4	83.1	82.9	82.9

TABLE VII.

*Shipping movement at United Kingdom ports.
Foreign trade, excluding trade with Irish Free State.*

1913.

[In thousand net tons.]

Port.	Arrivals.			Departures.		
	With cargo	In ballast.	Total.	With cargo.	In ballast.	Total.
General ports :						
London	11,713	2,012	13,725	8,291	3,113	11,404
Liverpool	9,375	2,679	12,054	9,548	1,661	11,209
Southampton	3,206	3,495	6,701	4,526	2,099	6,625
Hull	3,260	1,445	4,705	3,660	691	4,351
Glasgow	2,700	874	3,574	4,150	181	4,331
Plymouth	2,577	1,232	3,809	227	3,551	3,778
Middlesbrough	1,319	1,056	2,375	1,970	148	2,118
Manchester	1,596	282	1,878	1,216	269	1,485
Bristol	1,466	65	1,531	827	304	1,131
Lerth	1,043	565	1,608	1,292	227	1,519
Belfast	587	57	644	123	222	345
Total	38,842	13,762	52,604	35,830	12,466	48,296
Coal ports :						
Cardiff	1,412	6,205	7,617	9,650	797	10,447
Swansea	657	1,463	2,120	2,644	138	2,782
Newport	704	1,525	2,229	2,579	96	2,675
Port Talbot	103	721	824	1,076	59	1,135
Newcastle	1,276	5,943	7,219	6,820	1,677	8,497
Grimsby	978	1,521	2,499	2,161	594	2,755
Sunderland	241	1,367	1,608	1,871	122	1,993
Blyth	36	1,465	1,501	2,057	160	2,217
Hartlepool	649	487	1,136	594	219	813
Grangemouth	666	423	1,089	1,009	50	1,059
Methil	59	853	912	1,173	13	1,186
Total	6,781	21,973	28,754	31,634	3,925	35,559
Passenger ports :						
Dover	2,185	232	2,417	1,610	798	2,408
Harwich	926	41	967	816	125	941
Cowes	3	14	17	—	24	24
Folkestone	760	18	778	752	23	775
Weymouth	110	1,007	1,117	122	931	1,053
Newhaven	464	27	491	378	100	478
Total	4,448	1,339	5,787	3,678	2,001	5,679
Other ports	4,510	5,467	9,977	3,657	4,945	8,602
Grand total	54,581	42,541	97,122	74,799	23,337	98,136

TABLE VII—Contd.

*Shipping movement at United Kingdom ports.
Foreign trade, excluding trade with Irish Free State.*

1924.

[In thousand net tons.]

Port.	Arrivals.			Departures.		
	With cargo.	In ballast.	Total.	With cargo.	In ballast.	Total.
General ports :						
London	14,620	2,693	17,313	8,703	6,207	14,910
Liverpool	9,295	3,034	12,329	8,464	3,174	11,638
Southampton	5,366	3,762	9,128	5,195	3,907	9,102
Hull	4,484	961	5,445	2,683	2,157	4,840
Glasgow	3,036	783	3,819	3,822	703	4,525
Plymouth	2,433	1,978	4,411	118	4,183	4,301
Middlesbrough	1,206	1,250	2,456	2,147	266	2,413
Manchester	2,407	277	2,684	1,560	779	2,339
Bristol	2,032	260	2,292	1,040	949	1,989
Leith	1,137	307	1,444	1,192	332	1,524
Belfast	997	717	1,714	631	682	1,313
Total	47,013	16,022	63,035	35,555	23,339	58,894
Coal ports :						
Cardiff	1,490	4,820	6,310	7,606	1,102	8,708
Swansea	1,073	1,500	2,573	2,865	445	3,310
Newport	755	1,268	2,023	2,663	129	2,794
Port Talbot	307	525	832	965	88	1,053
Newcastle	1,339	5,860	7,199	6,364	2,157	8,521
Grimsby	819	1,351	2,170	1,456	851	2,307
Sunderland	163	1,151	1,314	1,588	68	1,656
Blyth	25	1,215	1,240	1,805	100	1,905
Hartlepool	535	388	923	506	256	762
Grangemouth	855	313	1,168	818	151	969
Methil	40	687	727	975	131	1,106
Total	7,401	19,078	26,479	27,613	5,478	33,091
Passenger ports :						
Dover	1,460	179	1,639	1,490	133	1,623
Harwich	1,372	20	1,392	1,138	236	1,374
Cowes	17	923	940	46	914	960
Folkestone	753	38	791	744	43	787
Weymouth	148	431	579	142	436	578
Newhaven	462	36	498	440	85	525
Total	4,212	1,627	5,839	4,000	1,847	5,847
Other ports	3,838	4,719	8,557	3,121	4,642	7,763
Grand total	62,464	41,446	103,910	70,289	35,306	105,595

TABLE VIII.

Shipping movement at ports—coasting trade, including trade with the Irish Free State, but excluding trade between the Irish Free State ports.

1913.

[In thousand net tons.]

Port.	Arrivals.			Departures.		
	With cargo.	In ballast.	Total.	With cargo.	In ballast.	Total.
General ports :						
London	5,726	637	6,363	2,340	6,248	8,588
Liverpool	2,184	1,337	3,521	2,326	1,912	4,238
Southampton	987	581	1,568	672	906	1,578
Hull	450	750	1,200	849	596	1,445
Glasgow	1,514	1,014	2,528	1,432	531	1,963
Plymouth	778	130	908	450	480	930
Middlesbrough	215	827	1,042	349	964	1,313
Manchester	545	262	807	802	599	1,201
Bristol	760	442	1,202	454	1,157	1,611
Leith	516	220	736	532	283	815
Belfast	2,330	372	2,702	1,915	1,205	3,120
Total	16,005	6,572	22,577	11,921	14,881	26,802
Coal ports :						
Cardiff	387	4,599	4,986	1,482	725	2,207
Swansea	306	949	1,255	405	189	594
Newport	198	1,204	1,402	445	544	989
Port Talbot	72	488	560	155	95	250
Newcastle	653	3,830	4,483	2,337	1,111	3,448
Grimsby	65	493	558	226	97	323
Sunderland	123	1,558	1,681	1,145	311	1,456
Blyth	4	959	963	179	78	257
Hartlepool	80	446	526	368	589	957
Grangemouth	309	174	483	179	264	443
Methil	10	493	503	186	42	228
Total	2,207	15,193	17,400	7,107	4,045	11,152
Passenger ports :						
Dover	162	27	189	69	128	197
Beaumaris and Holyhead	1,059	455	1,514	1,341	185	1,526
Harwich	78	166	244	47	223	270
Cowes	857	1,078	1,935	803	1,125	1,928
Folkestone	17	59	76	7	70	77
Weymouth	128	87	215	21	227	248
Newhaven	147	77	224	68	170	238
Total	2,448	1,949	4,397	2,356	2,128	4,484
Other ports	10,147	6,561	16,708	9,703	8,420	18,123
Grand total	30,807	30,275	61,082	31,087	29,474	60,561

TABLE VIII—*Contd.*
Shipping movement at ports, etc.
 1924.

[In thousand net tons.]

Port.	Arrivals.			Departures.		
	With cargo.	In ballast.	Total.	With cargo.	In ballast.	Total.
General ports :						
London	4,878	554	5,432	1,766	5,971	7,737
Liverpool	1,996	1,178	3,174	2,408	1,591	3,999
Southampton	530	586	1,116	432	724	1,156
Hull	313	520	833	532	875	1,407
Glasgow	1,193	1,045	2,238	1,239	555	1,794
Plymouth	426	82	508	260	341	601
Middlesbrough	95	727	822	198	740	938
Manchester	411	236	647	424	727	1,151
Bristol	547	573	1,120	337	1,095	1,432
Leith	460	260	720	520	160	680
Belfast	2,428	276	2,704	1,850	1,311	3,161
Total	13,277	6,037	19,314	9,966	14,090	24,056
Coal ports :						
Cardiff	258	3,503	3,761	765	796	1,561
Swansea	171	1,102	1,273	417	240	657
Newport	110	1,345	1,455	412	493	905
Port Talbot	24	370	394	43	152	195
Newcastle	378	3,266	3,644	1,763	767	2,530
Grimsby	16	455	471	229	165	394
Sunderland	74	1,615	1,689	1,244	183	1,427
Blyth	13	977	990	283	55	338
Hartlepool	9	346	355	222	344	566
Grangemouth	185	170	355	204	259	463
Methil	9	545	554	154	30	184
Total	1,247	13,694	14,941	5,736	3,484	9,220
Passenger ports :						
Dover	60	58	118	30	92	122
Beaumaris and Holyhead	1,486	520	2,006	1,804	193	1,997
Harwich	49	24	73	18	73	91
Cowes	447	1,262	1,709	356	1,336	1,692
Folkestone	13	65	78	1	81	82
Weymouth	55	47	102	15	83	98
Newhaven	98	64	162	2	135	137
Total	2,208	2,040	4,248	2,226	1,993	4,219
Other ports	7,611	6,415	14,026	7,462	7,455	14,917
Grand total	24,343	28,186	52,529	25,390	27,022	52,412
Irish Free State included	3,766	1,556	5,322	4,697	465	5,162

TABLE IX.

Shipping movements, 1925.

LONDON.

[In thousand net tons.]

Trade	Arrivals			Departures		
	With cargoes	In ballast.	Total	With cargoes.	In ballast	Total.
Foreign trade :						
British	10,492	2,174	12,666	7,018	4,268	11,286
Foreign	5,115	471	5,586	2,599	2,222	4,821
Coasting trade	4,650	689	5,339	1,553	5,814	7,367
Total .	20,257	3,334	23,591	11,170	12,304	23,474

LIVERPOOL.

Foreign trade :						
British	8,519	3,261	11,780	8,907	2,303	11,210
Foreign	1,645	166	1,811	692	785	1,477
Coasting trade	1,432	826	2,258	1,511	1,826	3,337
Total	11,596	4,253	15,849	11,110	4,914	16,024

SOUTHAMPTON.

Foreign trade :						
British	4,678	1,950	6,628	4,714	1,928	6,642
Foreign	784	1,862	2,646	986	1,635	2,621
Coasting trade	486	658	1,144	366	791	1,157
Total	5,948	4,470	10,418	6,066	4,354	10,420

NEWCASTLE, NORTH AND SOUTH SHIELDS.

Foreign trade :						
British	610	2,591	3,201	2,618	1,091	3,709
Foreign	635	2,049	2,684	2,403	719	3,122
Coasting trade	363	2,765	3,128	1,530	821	2,351
Total	1,608	7,405	9,013	6,551	2,631	9,182

TABLE IX—*Contd.**Shipping movements, 1925.*

CARDIFF.

[In thousand net tons.]

Trade.	Arrivals.			Departures.		
	With cargoes.	In ballast.	Total.	With cargoes.	In ballast.	Total.
Foreign trade :						
British	594	1,941	2,535	3,126	507	3,633
Foreign	751	2,212	2,963	3,413	247	3,660
Coasting trade	228	2,741	2,969	573	693	1,266
Total....	1,573	6,894	8,467	7,112	1,447	8,559

GLASGOW.

Foreign trade :						
British	2,862	747	3,609	3,940	480	4,420
Foreign	430	80	510	396	164	560
Coasting trade	880	1,053	1,933	864	606	1,470
Total....	4,172	1,880	6,052	5,200	1,250	6,450

HULL.

Foreign trade :						
British	2,630	489	3,119	1,358	1,411	2,769
Foreign	1,401	249	1,650	868	623	1,491
Coasting trade	333	455	788	477	788	1,265
Total....	4,364	1,193	5,557	2,703	2,822	5,525

PLYMOUTH.

Foreign trade :						
British	1,359	1,353	2,712	125	2,563	2,688
Foreign	1,270	885	2,155	66	2,050	2,116
Coasting trade	348	73	421	216	257	473
Total....	2,977	2,311	5,288	407	4,870	5,277

TABLE X.
Index-numbers of freight rates.

Area.	1920.	1923.	1924.	1925.
1. Northern Europe :				
Inward rate (timber)	100·00	29·12	29·40	26·37
Outward rate (coal)	100·00	18·26	15·38	13·16
Combined rates weighted	100·00	20·65	22·98	22·07
2. Western Europe (Atlantic and Western Mediterranean) :				
Inward rate (ore)	100·00	29·24	29·07	26·16
Inward rate (timber)	100·00	39·68	39·06	33·43
Outward rate (coal)	100·00	21·89	18·45	16·53
Combined rates weighted	100·00	25·76	23·12	20·69
3. Central and Eastern Mediterranean :				
Inward rate (grain)	100·00	29·25	31·09	29·11
Inward rate (space)	100·00	28·68	29·53	28·38
Outward rate (coal)	100·00	22·02	21·35	19·27
Combined rates weighted	100·00	21·37	23·40	21·30
4. West and South Africa :				
Inward rate (wool)	100·00	18·00	37·50	37·50
Outward rate (coal)	100·00	33·46	32·16	31·01
Combined rates weighted	100·00	21·43	36·06	34·83
5. East Africa to India :				
Inward rate (grain, &c.)	100·00	25·80	27·28	24·88
6. Eastern Asia, Pacific Islands :				
Inward rate	100·00	28·43	27·46	23·69
7. Australasia :				
Inward rate (grain)	100·00	24·16	28·89	30·04
Inward rate (wool)	100·00	76·92	76·92	76·92
Combined rates weighted	100·00	69·44	50·95	44·60
8. North America (Atlantic) :				
Inward rate (grain)	100·00	26·80	31·88	26·80
Inward rate (soft wood)	100·00	30·99	32·94	30·12
Inward rate (hard wood)	100·00	45·14	50·59	46·96
Combined rates weighted	100·00	28·34	32·78	32·60
9. West Indies, &c. :				
Inward rate (sugar)	100·00	25·54	27·93	23·48
10. South America (Atlantic) :				
Inward rate (grain)	100·00	19·86	22·93	15·46
Inward rate (meat)	100·00	62·11	59·63	57·14
Outward rate (coal)	100·00	36·21	33·15	39·73
Combined rates weighted	100·00	31·89	28·58	31·71
11. South and Central America (Pacific) :				
Inward rate (nitrate)	100·00	33·97	31·92	26·33
12. North America (Pacific) :				
Inward rate (grain)	100·00	33·02	34·65	31·07

TABLE XI.
Freight rates, 1913 and 1925.

Class of rate.	1913.	1925.	1925. (1913 = 100.)
Coal freights outwards :			
Cardiff or Newport to—	<i>s. d.</i>	<i>s. d.</i>	
Alexandria	9 9	10 8 $\frac{1}{2}$	109.61
Antwerp	5 1 $\frac{1}{2}$	3 2	61.79
Bordeaux	4 10 $\frac{1}{2}$	4 6 $\frac{1}{2}$	93.56
Gibraltar....	8 3 $\frac{1}{2}$	7 6 $\frac{1}{2}$	91.21
Havre	4 10 $\frac{1}{2}$	3 9 $\frac{1}{2}$	78.21
Las Palmas	8 9	8 10 $\frac{1}{2}$	101.43
Monte Video	16 8	15 6 $\frac{1}{2}$	93.37
Naples	9 0 $\frac{3}{4}$	9 2	101.15
Port Said....	9 6 $\frac{1}{2}$	10 6 $\frac{1}{2}$	110.26
River Plate (lower ports) ..	17 5 $\frac{1}{2}$	15 6 $\frac{1}{4}$	88.90
Tyne to—			
Alexandria	9 1	9 10 $\frac{1}{2}$	108.72
Antwerp	4 3	3 1 $\frac{1}{2}$	74.02
Genoa or Lavona	9 4	8 10 $\frac{1}{4}$	95.31
Hamburg....	3 9 $\frac{1}{2}$	3 11	103.30
Las Palmas	9 0	8 11 $\frac{3}{4}$	99.77
Leghorn	9 8	9 5	97.41
Port Said....	9 5 $\frac{1}{2}$	10 0 $\frac{1}{4}$	105.95
Rotterdam	3 7 $\frac{1}{2}$	3 10 $\frac{1}{2}$	106.94
Stettin	5 2 $\frac{3}{4}$	5 6 $\frac{1}{2}$	105.98
Firth of Forth to—			
Kiel	5 6 $\frac{3}{4}$	5 8 $\frac{1}{4}$	102.25
Stockholm	5 4	5 3	98.44
Grain freights homewards :			
America Northern range	2 7 $\frac{1}{2}$	3 1 $\frac{1}{2}$	119.05
Bahia Blanca	19 9	17 11 $\frac{1}{2}$	90.93
Buenos Aires	16 10 $\frac{1}{2}$	16 0 $\frac{1}{4}$	95.06
San Lorenzo	18 5 $\frac{1}{2}$	17 2 $\frac{1}{2}$	93.33
Australia	33 5 $\frac{1}{2}$	46 6 $\frac{1}{4}$	139.13
Danube	11 11	17 2 $\frac{1}{2}$	144.41
Mineral freights homewards :			
Algiers to Newport	5 0 $\frac{1}{4}$	6 0 $\frac{1}{2}$	120.33
Bilbao to Middlesbrough	5 4 $\frac{1}{2}$	6 5	119.38
Huelva to Garston	5 8 $\frac{1}{2}$	7 10 $\frac{1}{4}$	137.09
La Goulette to Middlesbrough	8 10 $\frac{1}{2}$	6 9 $\frac{1}{2}$	76.53
Timber freights homewards :			
Finland to East coast (stds.)	35 9	38 9 $\frac{1}{4}$	108.45
Miramichi to West coast	54 2 $\frac{1}{4}$	61 9 $\frac{1}{4}$	113.99
Gulf ports (America)	112 4	128 6 $\frac{1}{2}$	114.45
Other freights homewards :			
Alexandria to Hull	8 7 $\frac{1}{4}$	10 4 $\frac{1}{4}$	120.34
Bombay on d.w.	21 1 $\frac{1}{4}$	23 6 $\frac{1}{4}$	111.34
Calcutta on d.w.	23 8 $\frac{1}{4}$	28 11 $\frac{1}{4}$	121.95
Mauritius	20 3	23 8	116.87
Saigon	29 9	34 9 $\frac{1}{4}$	116.95
Nitrate ports	28 11	24 6 $\frac{1}{2}$	84.94

DISCUSSION ON MR. MACROSTY'S PAPER.

MR. H. M. CLEMINSON : Mr. Chairman, Ladies, and Gentlemen. I have been profoundly impressed with this paper and I think that any shipowner reading it would also be impressed. Mr. Macrosty suggests that the shipowners might be willing to give further information. We recently took steps to enquire of the shipowners whether they were disposed to do so, but the request did not meet with very ready response. In the present circumstances, when profits are meagre, the idea of increasing the burden of statistical investigation would not be welcomed. Any information made public in this country is available all over the world. This paper suggests that a good deal more use might be made of the figures now available, and I know the shipowners are only too ready to consider further applications for information, when they see that it would be of advantage to themselves or to the country.

To-day is the first time I have met Mr. Macrosty, but I have come across his work in various ways. I do not think I should help you very much if I attempted to make a criticism of the paper, but I should like, on behalf of the Chamber which I represent, to express the shipping industry's appreciation of the Board of Trade for the excellence of its work and its readiness to assist us with information which lies behind the public reports.

SIR CHARLES SANDERS : Mr. Chairman, Ladies, and Gentlemen. I have great pleasure in seconding the vote of thanks to an old colleague of mine, Mr. Macrosty. It is not the first time that the shipping industry—using it in its largest sense, including shipbuilding and repairing—has been under a debt of gratitude to Mr. Flux and his Department for valuable contributions to the statistics of shipping.

This is a long paper, entailing enormous labour to prepare, and I very much appreciate the way in which Mr. Macrosty has picked up the salient points for us to-night in presenting it. I congratulate him on the clever way in which he led us through the more important parts of the paper.

There are one or two things to which Mr. Macrosty referred as being minor points. I want to refer to one of them at any rate, as this paper is of great importance and will go all over the world in the *Journal* of the Society. I venture to make a suggestion about Mr. Macrosty's reference to tonnage. Tonnage measurement is a very complicated thing indeed. Mr. Macrosty says, "Gross tonnage is the internal capacity of the ship; net tonnage is the gross measurement less space for the crew, engines, boilers and bunkers." That is a pretty round definition for gross tonnage, but not exact enough regarding net tonnage. Bunkers are not in fact deducted from gross tonnage in order to arrive at the net tonnage, but certain other things not mentioned are deducted. Mr. Macrosty will understand my reference to this subject, as it used to be my special "job"

at the Board of Trade, and I think he will see that a little rearrangement of that statement is necessary in order to put things right.

I doubt very much Mr. Macrosty's statement that the net effect of the war was to reduce British tonnage by 2,000,000 tons. I know he has compared 1913 with the end of 1918, but the war did not break out until August, 1914, and during the intervening seven months something like 874,000 tons were built. He has omitted to give an account of the whole of the war shipbuilding programme, which was not completed until 1923.

Shipowners would be very glad to-day if the net result of the war was simply to reduce the tonnage on the British Register by 2,000,000 tons. We know that it increased it to such an extent that shipowners can hardly get a living because of the surplus of tonnage.

I suggest that Mr. Macrosty may think it well to add a note to the effect that he is not taking account of the completion of the war programme; it was all started during the war and because of the war, and the net result of the war has been a substantial increase in the tonnage of this country, for which there is no trade to-day.

The other point to which I would like to refer is the question of vessels broken up and sold to foreigners. Mr. Macrosty accounts for something like 104,000 steam tons, and when I looked into the figures given by Lloyd's Register—taken as the standard figures of the world—they show 608,000 gross tons of British steam- and motor-vessels of 100 tons gross and upwards broken up over the same period as that quoted by Mr. Macrosty.

As an old colleague I would cross swords with Mr. Macrosty as to his statement that the merchant fleet of 1924 was much more efficient than that of 1913. I do not think shipowners and shipbuilders would agree with him that that is the actual experience. I imagine that Mr. Macrosty has taken the figures as given by him on p. 464, where he put in a group all the vessels over thirteen years of age. Now it is a well-known fact that a vessel at thirteen years of age has just been through the first of her second series of classification surveys, and if she is up to date she starts on a new economic life. When thinking of age as a measure of efficiency, we should really think of the extremely old vessels on the Register.

Before the war there were 13 per cent. of these extremely old vessels in the British fleet; 6 per cent. were between twenty and twenty-five years old, and 7 per cent. were twenty-five years and upwards. To-day, according to Lloyd's Register statistics, the 7 per cent. has become 9 per cent., and the 6 per cent. has become 10 per cent.—a total of 19 per cent.—so that the fleet is really nothing like so efficient from that standpoint as it was before; and, of course, it is a well-known fact that we lost during the war the most efficient and up-to-date vessels. Shipowners ever since have been trying to replace, especially the liner type, at great increase of expenditure, to make up for that loss of efficiency. To-day I think it will be found that the age of the older portion of the fleet is worse than it was

before the war. It is necessary also to take into account the large number of vessels hurriedly built during the war for special war purposes which are still remaining in the mercantile fleet, and which by no manner of means could be considered as equally efficient as those fine vessels built at leisure and to the full specification of shipowners to suit their own individual trade.

The few remarks I have made in no way detract from my admiration of Mr. Macrosty's efforts in giving us a real analysis of what shipping statistics mean. I, myself, not only in connection with the Board of Trade figures with which I am more familiar, but in connection with the Ministry of Health and Home Office statistics, know that we have a vast amount of official information which really in some respects is full of romance—the romance of trade and industry.

The CHAIRMAN said that a letter had been received from Dr. ISSERLIS which he would ask the Honorary Secretary to read :—

“ To my great regret I shall not be able to be present to hear Mr. Macrosty's paper. I should like to give my hearty support to the vote of thanks that will be moved and to refer to a few points that have struck me in reading the paper.

“ Few people realize what a mine of valuable, nay, indispensable, statistical information on the composition and activities of British merchant shipping is compiled by the Statistical Department of the Board of Trade, and is presented with admirable compactness and lucidity in official publications. These official publications are backed by a vast store of informed knowledge, not only in the files of the Department, but in the minds of those directing it, and this knowledge is put freely at the disposal of all those who ask for it.

“ Those of us who continually turn to official statistics for guidance and help in our daily work, naturally become vocal when particular statistics are not to hand, but, like Oliver, when we ask for more we are testifying to the excellence of the first helping, and I am therefore anxious, before dealing with a few points arising on the paper, to record my thanks to the author for his illuminating analysis, and to the Department of which he is a member, for the excellent fare which it sets year by year before the statistical gourmet. Turning to the paper before the Society, I would like to draw attention to the following points :—

“ 1. The paper omits references to the semi-official statistics of shipping published by Lloyd's Register. Great value is attached to these by shipowners, as they enable international comparisons to be made. The paper also omits any reference to certain official statistics such as casualty returns.

“ 2. The analysis on pp. 463-4 of the size and age-constitution of British shipping at the end of 1924 and immediately before the war is of great interest. The difficulties in the comparison of age-constitution referred to on p. 464 can be got over by calculating from

the returns in the Annual Statement the median and quartile ages of the vessels on the Register in various groups of tonnage. On December 31, 1913, there were on the United Kingdom Register 12,602 steam- and motor-ships. Their median age was 10·38 years. The upper quartile was 4·92 and the lower quartile was 16·48 years. On December 31 1924, there were 12,513 ships; the median age had increased to 13·90, the upper quartile to 6·68, and the lower quartile to 21·04 years. The impression given by these figures—that United Kingdom steam- and motor-tonnage is older to-day than before the war—is, however, misleading. The 1913 total contained 8,672 ships not exceeding 1,500 gross tons. The 1924 total contained 9,232 such ships, and these are the vessels which are responsible for the apparent increase in age of the whole fleet.

“The following tables show the medians and the quartiles for steam- and motor-ships in six groups of tonnage :—

Median and quartile ages of groups, December 31, 1913.

Gross tons	Number	Lower quartile	Median	Upper quartile.
Up to 1,500	8,672	5·22	11·05	18·56
1,501-3,000	1,101	6·80	13·16	19·20
3,001-5,000	2,000	4·11	8·25	12·90
5,001-8,000	615	2·05	8·36	13·35
8,001-10,000	96	3·83	8·30	12·30
Over 10,000	118	1·72	5·10	11·29
Total .	12,602	4·92	10·38	16·48

Median and quartile ages of groups, December 31, 1924.

Gross tons	Number	Lower quartile	Median	Upper quartile.
Up to 1,500	9,232	8·69	14·99	23·57
1,501-3,000	802	2·88	9·67	17·76
3,001-5,000	1,050	7·09	13·04	17·20
5,001-8,000	1,071	3·79	6·07	11·94
8,001-10,000	174	3·97	8·50	14·48
Over 10,000	184	2·83	9·81	14·38
Total	12,513	6·68	13·90	21·04

“You will see from the tables, (a) that the median age of the vessels under 1,500 gross tons has increased by nearly 5 years; (b) that the handy-sized tramp vessels of from 1,500 to 3,000 gross tons have decreased from 1,101 to 802, and that they are considerably younger than in 1913. The next two classes, 3,001 to 5,000

gross tons and 5,001 to 8,000 gross tons, represent the ocean-going tramps, which are the great carriers of bulk cargoes to and from this country. The change in these vessels is very striking. The 3,001 to 5,000 tons class dropped from 2,000 in 1913 to 1,050 in 1924, while the 5,001 to 8,000 tons class increased from 615 in 1913 to 1,071 in 1924. In the whole there has been a fall in the number of these vessels, the number falling from 2,615 in 1913 to 2,121 in 1924, but owing to the increase in the average size of ocean-going tramps, the reduction in the tonnage has been proportionately small.

"The 2,000 tramps of the 3,001 to 5,000 tons class in 1913 had a total tonnage of 7,858,220 gross tons, and the 615 tramps of 5,001 to 8,000 tons had a total tonnage of 3,785,789 gross tons. Thus, broadly speaking, the tonnage of ocean-going tramps on that date amounted to 11,644,009 gross tons. In 1924 the 1,050 smaller tramps had a total tonnage of only 4,254,040 gross tons, but the larger tramps (of 5,001 to 8,000 gross tons) had a tonnage of 6,562,834 gross tons; so that the total tonnage amounted to 10,816,874 gross tons, and, consisting as it did of a smaller number of larger and more modern and faster vessels, these two classes probably represented a more efficient instrument for the transport of cargo, in spite of a reduction of over 800,000 gross tons.

"As regards age, the 1,050 smaller tramps were decidedly older in 1924 than in 1913; the median age increased from 18.5 to 19.4 years, but the larger tramps were decidedly younger, the median age showing a decrease from 18.6 to 16.0 years. This portion of the summary tables brings out a great change in the character of tramp shipping. As the median age of the 5,001 to 8,000 tons class was only 6.07 years on December 31, 1924, it follows that one-half of these larger cargo vessels have been built since the war.

"The most striking change in the character of British shipping, as compared with before the war, is, however, shown by the last two lines of the table. In 1913 there were only 96 steam- and motor-ships of 8,001 to 10,000 gross tons and 118 of over 10,000 gross tons, the total tonnage of the former being 844,760 gross tons, and of the latter 1,577,570 gross tons, a total of 2,422,330 gross tons.

"Roughly speaking, this total may be taken as representing the higher-class liner tonnage of the United Kingdom on December 31, 1913. It consisted of 214 ships of 2,422,330 gross tons. Some of the vessels in the 5,001 to 8,000 tons group were of course also liners. By December 31, 1924, the number of steam- and motor-ships in the 8,001 to 10,000 tons class had increased from 96 to 174 and the tonnage from 844,760 tons to 1,517,574, *i.e.* this class had nearly doubled both in number and in tonnage. The same is true of the next class—vessels of over 10,000 gross tons. These increased in number from 118 to 184, and the tonnage from 1,577,570 to 2,713,676 gross tons; so that, compared with 1913, the class of vessels which consists almost entirely of passenger liners increased from 214 to 258 in number, and from 2,422,330 to 4,231,250 gross

tons, an increase of 114 vessels and of 1,808,920 gross tons. (According to Lloyd's Register, these vessels six months later, on June 30, 1925, were 375 in number, totalling 4,498,422 gross tons.) More than one-half of these great liners have been built since 1913, as the median age of the 8,001 to 10,000 tons class was only 8.5 years on December 31, 1924, and that of the over 10,000 tons class was only 9.1 years.

"It is true that these liners are rather older than the corresponding classes in 1913, but this is accounted for by the fact that the construction of vessels over 10,000 gross tons was in 1913 a comparatively recent development, one-half of the vessels in this class being in December, 1913, under 5.1 years of age.

"The general conclusions to be drawn from this table are, that if attention be confined to ocean-going vessels of over 1,500 gross tons, the merchant marine of the United Kingdom to-day (a) consists largely of modern vessels; (b) includes fewer small tramps of 1,501 to 3,000 gross tons, but these smaller tramps are younger than the corresponding class before the war; (c) the class of moderate-size tramps of 3,001 to 5,000 gross tons has dropped by about 50 per cent. in number. Few vessels of this size are being built, and it is for this reason that their average age is higher than before the war. The class of large tramps and cargo liners 5,001 to 8,000 gross tons has increased by over 50 per cent. in number, and is of much more modern construction than the corresponding class before the war; (d) the passenger-liner class is nearly double in number and tonnage, and consists largely of modern post-war vessels. The ocean-going mercantile marine of the United Kingdom is a more efficient, and in its more important divisions a more modern, fleet than pre-war. In spite of the shipping depression, the post-war years have seen a practical rebuilding of the shipping of the United Kingdom, and have witnessed its rapid conversion from a fleet of which the backbone was the tramp vessel to a fleet in which the balance leans heavily towards the cargo-liner and passenger-liner type.

"This note is already too long, but I feel that some comparison should be made of the age and size of British cargo-liner and passenger-liner tonnage with foreign-owned tonnage of this character. From tables in the 1925-6 edition of Lloyd's Register Book, it appears that 48.7 per cent. of the steam- and motor-tonnage of 8,000 gross tons and upwards is owned in the United Kingdom. For vessels of 10,000 to 15,000 gross tons the percentage is 52.5; for vessels of 15,000 to 20,000 tons it is 65.7; and for vessels of 20,000 gross tons and above it is 64.3. As regards age, 51.4 per cent. of the tonnage of 8,000 gross tons and above owned in the United Kingdom is under 10 years of age. For the tonnage owned abroad the percentage is 64.9. The difference is still more favourable in the case of vessels of 15 to 20,000 gross tons where 71.9 per cent. of the tonnage owned in the United Kingdom is under 10 years old compared with 55.8 per cent. abroad. The disinclination to build monster ships is shown by the fact that in the case of vessels of 20,000 gross tons and over,

the percentage under 10 years of age falls to 51.1 per cent. in the United Kingdom and 51.3 per cent. abroad.

" I have dealt with this part of the paper at great length, because it does seem to me important to bring out the fact that, while in the last eleven or twelve years the foreign tonnage of the world has increased by about 15,000,000 gross tons, and the United Kingdom tonnage has remained practically stationary in amount, the ocean-going part of the latter has been largely reconstituted, and consists mostly of younger vessels more appropriate for the changing form of seaborne trade. This is substantially the same conclusion as expressed by Mr. Macrosty on p. 464.

" I have no space to deal with the admirable analysis of the distribution of shipping services by areas. The classification formerly employed in the Board of Trade Returns in which the movement of shipping to and from political States was shown had certain solid advantages, as occasions arise in which it is desirable to measure the size of the target exposed to acts of discrimination by foreign States and possibly the size of the target exposed to justifiable acts of reprisal.

" I support heartily Mr. Macrosty's remarks on the use that could be made of Lloyd's Daily Index in order to get an adequate picture of the movement of the world's ships and cargoes, and hope that the Society of Lloyd's will favourably consider his suggestions.

" 3. I should have liked to deal in detail with the section on gross shipping earnings, p. 500 and onwards.*

" At the top of p. 504 the agreement between the two index-numbers is surprisingly close. Personally, I attach more weight to the variations in an index-number than to its absolute magnitude, as it would be a bold thing to claim that an index-number is correct to within, say, 10 per cent.

" The loading factors at the top of p. 505 convey very little, as coal forms such a preponderating part of the weight of the exports. If coal be allowed for, it appears that the loading factor outwards for the improved vessels of the cargo-liner and liner type has fallen considerably as compared with before the war.

" Mr. Macrosty's paper is of the very greatest value, and I am grateful to the Department he represents, and to himself, for the body of shipping statistics, more complete and more accurate than those available in the case of any other country, and for the able way in which Mr. Macrosty has expounded these statistics."

Sir LIONEL FLETCHER said he had only one or two comments to make. First of all, he did not think that it was necessary for him to thank Mr. Macrosty for his paper, as this had been done so excellently by the previous speakers.

It was news to him to know that a ship could be in ballast and

* I consider that the gross receipts and the expenditure abroad are both understated, but that the net figures obtained are not far out.

still be carrying passengers ; he had been under the impression that a ship with passengers had to pay dues.

After the war an attempt was made to write a history of the work done by the Ministry of Shipping and Transport Department. It was considered desirable that some form of record should be kept. He thought he was right in saying that one of the recommendations contained in it was that a card-index of movements should be kept by Lloyd's during peace time, so that in the case of another war the card-index could be taken over by the Admiralty, and in this way, on the day war began, the Trade Division would know where the ships were and how they were moving. He did not know if this had been done, but he felt sure that such a thing would be welcomed by the Admiralty, and it was one of the strong points of Mr. Macrosty's paper.

Mr. R. Y. SANDERS said there was one small point following on the remarks made by the last speaker. Some two years ago he had contemplated privately the question of the utilization of Lloyd's Index in a manner similar to that suggested by Mr. Macrosty, and had actually taken the record of a few vessels over the year 1924. He had dug up one of the records, which might be of interest to Mr. Macrosty. The point was that Lloyd's Index was not a daily record, but a daily report of the last record that had been received, and for his special point of view—the relative time spent in port and at sea—there were therefore several gaps ; the result would not have been of much value until these had been filled.

He did not know if Mr. Macrosty was aware of the Admiralty charts that had been published for vessels over 3,000 tons ; these gave certain information bearing on the same point.

Mr. FLUX said his mind had been rather more on his duties as Secretary than on joining in the debate, though it gave him very great pleasure to express, with others, his appreciation of the very careful and able work that Mr. Macrosty had devoted to his paper.

With reference to shipping statistics, the Board of Trade would like various things ; in particular it would like to find out the kind of statistics that were of assistance to those who had to use them, and one of the great services that the presentation of Mr. Macrosty's paper to the Society might render was to call the attention of some persons, who might shy at the Blue Book, to what was inside it, and lead them to make suggestions as to what they would like to see inside it, or perhaps to call their attention to the fact that there was something there that they did not know, and that might be useful to them.

The field of shipping statistics was a peculiarly difficult field to deal with. A large part of the record was a record of the movement of shipping between places—a record that would be simple and easily intelligible if every ship loaded up all its cargo at one particular port, carried it to another port, and unloaded all of it there.

The figures of the movement of vessels should, so far as possible, picture the movement of trade, but the actual facts were increasingly different from that; that was to say, that vessels carried cargoes parts of which were destined to a great many different countries. or they might load up at different countries. In the comparison of one period with another, if a change in this respect were in progress, one might easily be misled by comparison of the figures of the records. If the growth of the cargo-liner was introducing a larger element of the direct country-to-country trade with no intervening calls, great care should be taken in bringing over against one another the figures of pre- and post-war periods; in the one case a vessel might be recorded against a country in which only the most distant of several ports of call was situated, whereas in the other case the vessel might be going direct from one terminus to another without intermediate calls. If things of this kind were happening, the Board of Trade would like to have attention called to it. This might be done if an analysis could be made of the actual movements of vessels instead of having the records of the ends of the journeys only.

It might then, perhaps, be possible to devise some statistics that would have real meaning, and if various countries united in such changed methods, really comparable figures for different countries might be available. The comparison of figures at present was a difficult task. The type of statistics available elsewhere was similar to our own.

He said that the international point of view often presented itself to him, because one of the things he had to do was to consider the comparison of statistics between different countries, and one was thrown up against serious difficulties in such international comparisons. To start with, there was the difficulty as to whether all countries treated alike the question of vessels classed as in ballast. Before 1912, in this country vessels were counted as not with cargo if the only things they loaded or landed were mails or bullion, and cargoes of very large value might be loaded but left out of account because they were in the shape of mails, with valuable packets of diamonds in them, and bars of gold. Since 1912 mails had been counted as cargo, and vessels that loaded or landed mails without loading or landing other cargo were counted as with cargo.

In international comparison it is necessary to take account of the treatment accorded to passenger vessels, or vessels handling mails only, etc., and whether a vessel that had cargo on board, on coming into a port for other purposes than landing or loading cargo, was to be recorded as in ballast. If a vessel came into a port in this country and did not unload she was counted as arriving in ballast. There was, in fact, a defect in wording, and it would be better if it were possible to introduce two descriptions, one of which would represent that the vessel recorded as arriving at a port was really unloading cargo at that port, and the other would indicate that the vessel, though loaded, was not unloading cargo at that port, when there

would be a clearer distinction. As it was, the interpretation of the phrase "in ballast" in different countries was not quite identical.

Then there was the other point of where a vessel was bound to or from. Some countries classified a departing vessel against the first country at which any of the cargo she carried would be unloaded, whereas Great Britain took the last of such countries as the basis.

He referred to these things by way of illustrating some of the tangles through which Mr. Macrosty had been steering his way, and some of the warnings that still remained and must be borne in mind in comparing British statistics with those of different countries. To have such guidance through the complex tables of the Blue Books as Mr. Macrosty had given, even subject to the few amendments suggested by Sir Charles Sanders, was an extremely valuable thing, and one much wanted from time to time. In the last few years there had been several Fellows of the Society who had offered that kind of guidance through the statistics with which they were particularly concerned. It was a valuable assistance, and the Society's warmest thanks were due to Mr. Macrosty for the service he had rendered, the more so in this case as it was to be hoped that it might refresh interest in this important body of statistics.

It was a long time since the Society had had a review of shipping statistics; there had not been a proper review of that kind since the late Sir John Glover gave the last of his decennial surveys in 1902. Such a paper was therefore well overdue, and the presentation of such papers from time to time was a great service to the Society, since it helped the Society to use its influence in the proper places to secure that appropriate amendments in the mode of preparing and issuing statistics should be made.

Although Mr. Macrosty and himself might be responsible for this particular department of statistics, they did not flatter themselves that they could do without advice from those who knew more than they did about the practical applications of the statistical information, and they were humbly grateful for advice that enabled them to do their work better than they had hitherto been able to do it.

Dr. GREENWOOD, in putting the vote of thanks to the Meeting, said that he felt sure Mr. Macrosty would realize that the small number of speakers, notwithstanding the high qualities of their utterances, merely represented the fact that shipowners were strong, silent men. Unfortunately the vital statistics of the industry, which interested him, were confined to the figures published by the Registrar-General, and these were not free from difficulty of interpretation. Seamen who were ill came home to die, and the high rates of mortality for certain causes might be due to the incomplete specification of the number of lives at risk.

He regretted that more gentlemen directly concerned with shipping were not able to be present at the meeting. He felt sure that every Fellow and visitor present would wish to express a most cordial

vote of thanks to Mr. Macrosty for his interesting and valuable paper.

(The vote of thanks, moved by Mr. H. M. CLEMINSON and seconded by Sir CHARLES SANDERS, was put to the meeting and carried unanimously.)

Mr. H. W. MACROSTY, replying, said that Dr. Isserlis had disposed of the more important part of Sir Charles Sanders's criticisms, that relating to the age of merchant ships. With regard to what he had said concerning the inclusion of bunker spaces in the deductions to arrive at net tonnage, the difference between them was more verbal than real. He agreed that the full effect of the war on British shipping was not shown by his figures, and he would add some supplementary particulars. The official statistics of ships broken up and those published by Lloyd's did not refer to the same thing. He cordially thanked the meeting for their appreciation of his paper.

Mr. Macrosty has supplied the following notes on the points raised by Sir Charles Sanders :—

Note 1.—The summary of deductions to arrive at net tonnage was taken from an article by the late Sir Douglas Owen in Nelson's Encyclopædic Library ("Ships and Shipping," vol. ii., p. 149), in which he said: "Apparently, under Board of Trade tonnage-measurement rules, the engine-space to be allowed is that lying between the water-tight bulkheads fore-and-aft of the engine-room, in which are contained the engines, boilers, and bunkers." Under the Merchant Shipping Acts 1894 and 1907, where the tonnage of "the space solely occupied by and necessary for the proper working of the boilers and machinery" of a screw-steamer is over 13 and under 20 per cent. of the gross tonnage, the deduction for propelling power is to be 32 per cent.: in other screw-steamers, if either the Board of Trade or the owner desire, the space is to be measured and to that measurement three-fourths of that space and the shaft-trunk are to be added to arrive at the deduction; the deduction (except for tugs) is not to exceed 55 per cent. of the tonnage remaining after deduction of crew space and spaces for steering-gear, charts, signals, etc. The bunker spaces are not actually included in the spaces that are measured, but in the allowances lies the reconciliation between the statements by Sir Douglas Owen and Sir Charles Sanders.

Note 2.—On July 31, 1914, there were on the British Register approximately 21,029 vessels of 12,423,114 net tons. Between that date and December 31, 1918, there were added to the register 3,177 vessels of 4,399,808 net tons, of which 1,805 vessels of 2,763,108 net tons were constructed in British yards. Deductions by war loss, sale, etc., were 6,015 vessels of 6,721,987 net tons. A good part of the war shipbuilding programme was not completed at the Armistice and was carried over into later months.

Note 3.—Particulars as to vessels “broken up” are ascertained only when the owners remove them from the register as broken up or to be broken up in the United Kingdom; if they are broken up after sale to foreign purchasers, that fact is not usually known to the British authorities and they are included with other vessels “sold to foreigners.” It is understood that Lloyd’s include in their figures all vessels over 100 tons gross which were known to them to be broken up, and in the six years their Returns record 220 vessels of 545,929 tons gross; the net tonnage is not stated, but it may have been about 330,000 or 340,000 tons net.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society:—

Ivor Meurig Jones.

Richard Lithgow.

David Sirkin, A.S.A.A.

Charles Henry Spray.

James Stone, A.S.A.A., A.O.W.A.

Leslie Alfred Terry.

Hilda M. Woods.

MISCELLANEA.

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THE COMPARISON OF TWO SETS OF OBSERVATIONS.

(Part of a Thesis approved for the Degree of D.Sc. in the University of London.)

By E. C. RHODES.

WHEN we compare two sets of observations, why do we consider the ratio of the difference between the means to the standard deviation of this difference? This question appears to be of interest, and will be considered in the following.

1. Let us consider first what information can be obtained from one set of observations. Let us suppose that an unknown quantity X is being measured, and that errors enter into the measurements, these errors being supposed distributed according to the normal law with standard deviation σ . We shall have as the chance of the occurrence of errors lying between $e_1, e_1 + de_1; \dots e_n, e_n + de_n$, the expression

$$\frac{1}{(\sqrt{2\pi}\sigma)^n} e^{-\frac{1}{2} \sum_{i=1}^n \frac{e_i^2}{\sigma^2}} \prod_{i=1}^n de_i.$$

From which we deduce the chance of obtaining a set of observations lying between $u_1, u_1 + du_1; \dots u_n, u_n + du_n$:—

$$\frac{1}{(\sqrt{2\pi}\sigma)^n} e^{-\frac{1}{2} \sum_{\nu=1}^n \frac{(u_\nu - \bar{X})^2}{\sigma^2}} \prod_{\nu=1}^n du_\nu \quad . \quad . \quad . \quad . \quad (i)$$

(a) Now we can proceed from this to obtain estimates of X , σ based on actual occurrences. Let us suppose that actually there

have been observed measurements x_1, x_2, \dots, x_n of this unknown. The chance that we should get measurements lying between $x_1; x_1 + dx_1; \dots, x_n, x_n + dx_n$; when we measure X , the same system of errors being supposed liable to occur, is

$$\frac{1}{(\sqrt{2\pi}\sigma)^n} e^{-\frac{1}{2} \sum_{v=1}^n \frac{(x_v - X)^2}{\sigma^2}} \prod_{v=1}^n dx_v.$$

Now for a given system x_1, \dots, x_n . This last expression will vary according to variations in X, σ , the variable part being

$$z = \frac{1}{\sigma^n} e^{-\frac{1}{2} \sum_{v=1}^n \frac{(x_v - X)^2}{\sigma^2}} \dots \dots \dots \quad (\text{ii})$$

From this expression are deduced estimates of X and σ . These values are given by

$$X = \sum_{v=1}^n \frac{x_v}{n} = \bar{x}, \text{ the mean } \bar{x}.$$

$$\sigma^2 = \sum_{v=1}^n \frac{(x_v - \bar{x})^2}{n} = v^2 \text{ (say),}$$

where v is the mean square error of the observations.

(b) From (i) we can also proceed to find the chance of obtaining sets of observations less likely to occur than given observations. Suppose the given observations are x_1, x_2, \dots, x_n , we have the chance of obtaining, when we make n measurements, sets of observations less likely to occur than those observed, is

$$\text{const.} \int_{\chi}^{\infty} e^{-\frac{1}{2}\chi^2} \chi^{n-1} d\chi \dots \dots \dots \quad (\text{iii})$$

the limiting χ being given by

$$\chi^2 = \sum_{v=1}^n \frac{(x_v - \bar{x})^2}{\sigma^2} \text{ (the well-known result).}$$

In order to use this we need to substitute for X and σ . If we use the values obtained in (a) above, the estimates derived from the given observations, we get $\chi^2 = n$.

Now it is known that the value of (iii) is very close indeed to 0.5 when the limiting χ is equal to $\sqrt{n - 2/3}$, so we see that our chance is very close to 0.5, being slightly less than this value. For instance, if we have ten measurements of an object, 8, 12, 6, 9, 11, 6, 9, 5, 6, 8 (measurements in inches), the chance is roughly 0.5 that we get these observations or others less likely to occur together

likely should occur, rather than the statement that it is a certainty that the mean of a set of observations will be that observed or a value less likely. The foregoing may appear very elementary, and the work involves nothing new, but I find it very useful to emphasize the fact that a set of observations is not entirely represented by the mean. In fact, in the particular case under discussion, we can really get the result *a priori*, on the grounds that we might have observations more likely or less likely, and the odds are equal that we get either one or the other.

The object of the present paper is to indicate that the ordinary method of comparing two sets of observations, by considering the difference between the means, is really a method based on comparing the two unknown quantities measured, when these quantities are supposed different, and the most likely estimates are used for these unknowns. The most likely values are obtained by using the arguments of inverse probability. I propose to show that the usual method is not based on the consideration of two sets of measurements of the same quantity; and a pre-requisite to the argument is the discussion above, where the important point is that the mean of a set of observations does not contain all the information which is given by the observations themselves taken as a whole.

2. If we consider the chance of obtaining two sets of observations of the same quantity X , the errors involved in the first set being distributed with standard deviation σ and in the second set with standard deviation σ' , the first set of observations lying between $u_1, u_1 + du_1, \dots u_n, u_n + du_n$; the second set lying between $v_1, v_1 + dv_1, \dots v_m, v_m + dv_m$, the chance is

$$\frac{1}{(\sqrt{2\pi}\sigma)^n} e^{-\frac{1}{2} \sum_1^n \frac{(u_v - X)^2}{\sigma^2}} \prod_1^n du_v \cdot \frac{1}{(\sqrt{2\pi}\sigma')^m} e^{-\frac{1}{2} \sum_1^m \frac{(v_v - X)^2}{\sigma'^2}} \prod_1^m dv_v \quad (v)$$

Let us consider this expression, and obtain from it estimates of X, σ, σ' . If there were made actual measurements, $x_1, x_2, \dots x_n; y_1, y_2, \dots y_m$, we can consider as in §1 (a) the variations of

$$\frac{1}{\sigma^n} e^{-\frac{1}{2} \sum_1^n \left(\frac{x_v - X}{\sigma} \right)^2} \frac{1}{\sigma'^m} e^{-\frac{1}{2} \sum_1^m \left(\frac{y_v - X}{\sigma'} \right)^2} \dots \quad (vi)$$

for varying X, σ, σ' . This expression is a maximum for values of X, σ, σ' given by

$$\sum_1^n \frac{(x_v - X)}{\sigma^2} + \sum_1^m \frac{(y_v - X)}{\sigma'^2} = 0,$$

$$\sum_1^n \frac{(x_v - X)^2}{\sigma^3} - \frac{n}{\sigma} = 0; \quad \sum_1^m \frac{(y_v - X)^2}{\sigma'^3} - \frac{m}{\sigma'} = 0 \quad \dots \quad (vii)$$

Further, we can obtain from (v) the chance of obtaining the given sets of observations or others less likely to occur. It is, again, using the well-known result

$$\text{const.} \int_{\chi}^{\infty} e^{-\frac{1}{2}\chi^2} \chi^{n+m-1} d\chi.$$

Where the limiting χ is given by

$$\chi^2 = \sum_1^n \frac{(x_v - \bar{X})^2}{\sigma^2} + \sum_1^m \frac{(y_v - \bar{X})^2}{\sigma'^2}.$$

If we substitute in this last for \bar{X} , σ , σ' estimates based on maximizing (vi) we get $\chi^2 = n + m$. It should be noted that we get this value when we find equations for σ , σ' by making (vi) vary in σ, σ' only, \bar{X} being any value whatever, and considering when it is a maximum. Again the chance is roughly 0.5 that the observed sets are found to occur or other sets less likely. Thus the whole information to be obtained from the observations is that the chance is one-half that we get the specified observations or others less likely to occur, a result which could really be obtained by *a priori* reasoning.

If we consider the restricted information from the means, we have the chance that the mean of the first set lies between \bar{u} , $\bar{u} + d\bar{u}$ and the mean of the second set lies between \bar{v} , $\bar{v} + d\bar{v}$ is

$$\frac{1}{\sqrt{2\pi}\sigma_{\bar{u}}} e^{-\frac{1}{2}\frac{(\bar{u}-\bar{X})^2}{\sigma_{\bar{u}}^2}} d\bar{u} \cdot \frac{1}{\sqrt{2\pi}\sigma_{\bar{v}}} e^{-\frac{1}{2}\frac{(\bar{v}-\bar{X})^2}{\sigma_{\bar{v}}^2}} d\bar{v} \dots \quad (\text{viii})$$

where

$$\sigma_{\bar{u}} = \frac{\sigma}{\sqrt{n}}, \quad \sigma_{\bar{v}} = \frac{\sigma'}{\sqrt{m}}.$$

From this, directly, we obtain the chance of observing means \bar{x} , \bar{y} , or others less likely is the usual result

$$\int_{\chi}^{\infty} e^{-\frac{1}{2}\chi^2} \chi d\chi,$$

where the limiting χ^2 is given by

$$\chi^2 = n \frac{(\bar{x} - \bar{X})^2}{\sigma^2} + m \frac{(\bar{y} - \bar{X})^2}{\sigma'^2}.$$

If we substitute in this equation the values of \bar{X} , σ , σ' estimated as above, we get a value for χ^2 which depends on the observations x 's and y 's. But for reasons set forth above I do not think that this line of approach should be used, as we are only utilizing a restricted amount of the available information, when we argue about the means of observations, instead of using the whole information contained in the sets of observations themselves.

Still less should we consider the argument, wherein we deal with the chance of the difference of the means $\bar{n} - \bar{v}$.

From (viii) we can, by restricting ourselves still further, consider the chance that the difference between the means lies between w and $w + dw$. It is

$$\frac{1}{\sqrt{2\pi} \sigma_w} e^{-\frac{1}{2} \frac{w^2}{\sigma_w^2}} dw,$$

where
$$\sigma_w^2 = \frac{\sigma^2}{n} + \frac{\sigma'^2}{m}.$$

The chance that we get the difference observed $(\bar{x} - \bar{y})$ or other differences less likely is

$$2 \int_{\frac{\bar{x} - \bar{y}}{\sigma_w}}^x \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2} \theta^2} d\theta,$$

where the limit of integration $\frac{\bar{x} - \bar{y}}{\sigma_w}$ is given by a complicated expression in the original x 's, y 's observed, when we substitute for X, σ, σ' the estimates given by the equations (vii). We may note that the equations (vii) give

$$X \left(\frac{n}{\sigma^2} + \frac{m}{\sigma'^2} \right) = \frac{n\bar{x}}{\sigma^2} + \frac{m\bar{y}}{\sigma'^2},$$

$$\sigma^2 = v^2 + (\bar{x} - X)^2, \quad \sigma'^2 = v'^2 + (\bar{y} - X)^2,$$

where
$$v^2 = \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2, \quad v'^2 = \frac{1}{m} \sum_{i=1}^m (y_i - \bar{y})^2.$$

The value of σ_w^2 is certainly not $\frac{v^2}{n} + \frac{v'^2}{m}$. The only method of obtaining this value would be to consider the first part of (vi) and show that estimates of X, σ are \bar{x}, v ; then consider the second part of (vi) and show that estimates of X, σ' are \bar{y}, v' ; that is to say, for σ , using \bar{x} for X , and for σ' , using \bar{y} for X . Such a method of procedure is, of course, absurd.

It may be noted that if it is assumed that $\sigma = \sigma'$, the problem of § 2 simply becomes the same as that considered in § 1.

We are thus led to the conclusion that all we can say of two sets of measurements of the same quantity is that we are equally likely to get more or less probable sets of measurements. Yet the fact remains that it is a universal custom, when dealing with such observations as we are considering here, to take the difference $(\bar{x} - \bar{y})$

between the means of observations and compare this difference with $\sqrt{\frac{v^2}{n} + \frac{v'^2}{m}}$. What, then, is the basis of this method? What does this relation indicate? I propose to show that this method of comparison is the result of an argument which involves inverse probability. I propose to show that this method follows when we consider, instead of the question, "How close are the means of two sets of observations of the same unknown quantity?" this question, "How close are two entirely different unknowns of each of which we have certain measurements?"

3. Let us take the chance that the unknown lies between X and $X + dX$, and that observations made on the unknown lie between $x_1, x_1 + dx_1, \dots, x_n, x_n + dx_n$, as

$$\frac{C}{(\sqrt{2\pi}\sigma)^n} e^{-\frac{1}{2} \sum_1^n \frac{(x_i - X)^2}{\sigma^2}} \prod_1^n dx_i dX. \quad \dots \quad (\text{ix})$$

From which we obtain the chance that the measurements lie between the given values, whatever X may be, as

$$\frac{C}{(\sqrt{2\pi}\sigma)^{n-1}} \cdot \frac{1}{\sqrt{n}} e^{-\frac{1}{2} \sum_1^n \frac{(x_i - \bar{x})^2}{\sigma^2}} \prod_1^n dx_i, \quad \dots \quad (\text{x})$$

and from (ix) and (x) obtain the chance that the unknown measured lies between X and $X + dX$; it is

$$\frac{\sqrt{n}}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2} \frac{(X - \bar{x})^2}{\sigma^2}} dX \quad \dots \quad (\text{xi})$$

I am here merely stating the usual arguments for obtaining a knowledge of the unknown from the set of observations. To get an idea of σ , for use in (xi), we can consider what value of σ will make (x) a maximum, the x 's being fixed. This value is given by

$$\sigma^2 = \frac{\sum_1^n (x_i - \bar{x})^2}{n-1} = \frac{n}{n-1} \cdot v^2.$$

We can, by considering a second set of m observations y_1, y_2, \dots, y_m , deduce in exactly the same way the chance that the unknown measured this time lies between Y and $Y + dY$. It is

$$\frac{\sqrt{m}}{\sqrt{2\pi}\sigma'} e^{-\frac{1}{2} \sum_1^m \frac{(y_i - \bar{y})^2}{\sigma'^2}} dY \quad \dots \quad (\text{xii})$$

where σ' is taken to be $\sqrt{\frac{m}{m-1}} \cdot v'.$

From (xi) and (xii) we can obtain the chance that the quantity measured in the first case lies between X and $X + dX$, and at the same time that the quantity measured in the second case lies between Y and $Y + dY$: this chance being the product of (xi) and (xii)

$$\frac{\sqrt{nm}}{2\pi\sigma\sigma'} e^{-\frac{1}{2}\left(n\frac{(X-\bar{x})^2}{\sigma^2} + m\frac{(Y-\bar{y})^2}{\sigma'^2}\right)} dX dY. \quad \dots \quad (\text{xiii})$$

Now we wish to argue from the observations made as to the quantities measured, and such arguments will be based on (xi) and (xii). The point we are interested in is this: Are X and Y the same, or nearly the same, or can we arrive at any conclusion such that they are reasonably the same? The natural thing to do is to consider the difference between X and Y , so from (xiii) we can deduce the chance that this difference lies between any given limits. We get the chance that $X - Y$ lies between z and $z + dz$ is

$$\frac{1}{\sqrt{2\pi}\sigma_z} e^{-\frac{1}{2}\left(\frac{z-\bar{z}}{\sigma_z}\right)^2} dz \quad \dots \quad (\text{xiv})$$

where

$$\sigma_z^2 = \frac{\sigma^2}{n} + \frac{\sigma'^2}{m} = \frac{v^2}{n-1} + \frac{v'^2}{m-1}.$$

It is thus seen that the distribution of the difference between the quantities measured is normal about $\bar{x} - \bar{y}$ (the difference between the most likely X and the most likely Y) with variability given by

$$\sigma_z^2 = \frac{v^2}{n-1} + \frac{v'^2}{m-1}.$$

Thus the most likely difference is not zero, but $\bar{x} - \bar{y}$. Now we want to know what is the chance that the difference between X and Y is reasonably zero, and this chance will depend on what we mean by the word "reasonably." We note that when \bar{x} and \bar{y} are equal, the difference between X and Y is distributed about zero, and let us agree that the fact of \bar{x} and \bar{y} being equal would mean that for practical purposes the quantities might reasonably be taken as the same. We know that practically the whole of the frequency of a normal curve is included in a range of abscissa two and a-half times the standard deviation on either side of the mean. Let us, then, take all the values of the difference between X and Y on either side of zero up to two and a-half times the standard deviation as being equivalent to zero for all practical purposes. Then we have some idea of what we

might mean by the word "reasonably." Let us take the difference between X and Y as reasonably zero when it is less than two and a-half times the standard deviation. Now we can obtain conclusions from (xiv). The mean of this distribution is $(\bar{x} - \bar{y})$, and the position of the zero difference relative to the mean depends on the size of $(\bar{x} - \bar{y})$. If $(\bar{x} - \bar{y})$ is large, the zero on the scale of differences is a long way from the mean of the distribution represented by (xiv), and a range of two and a-half times the standard deviation on either side of zero may not include the mean. Whether it does or not depends on the size of the standard deviation. We can see that if the distance of the zero of the scale of differences is more than two and a-half times the standard deviation from the mean $(\bar{x} - \bar{y})$, then the chance of our difference being reasonably zero is less than half, and if this distance is less than the limiting value mentioned, the chance of our difference being reasonably zero is greater than half. This is equivalent to saying that if the $(\bar{x} - \bar{y})$ observed is greater than two and a-half times $\sqrt{\frac{v^2}{n-1} + \frac{v'^2}{m-1}}$, the odds are against the difference between the quantities measured being reasonably zero, and if $(\bar{x} - \bar{y})$ is less than two and a-half times $\sqrt{\frac{v^2}{n-1} + \frac{v'^2}{m-1}}$, the odds are in favour of the difference between the quantities measured being reasonably zero. If we use this criterion, we can say that the odds are in favour of the quantities measured being the same when the difference between the observed means $(\bar{x} - \bar{y})$ is less than two and a-half times $\sqrt{\frac{v^2}{n-1} + \frac{v'^2}{m-1}}$, and if the difference between the means is greater than this, the odds are against the quantities measured being reasonably the same. This criterion was also considered in a paper by the author relating to a kindred subject in *Metron* (V, 2, 1925).

It will be seen that this method of testing the reasonableness or otherwise of the two quantities measured being the same is substantially the well-known test in everyday use. I submit that the above is the only way of showing the development of the usual test, that it is a test of the quantities measured being the same for all practical purposes, and not a test of whether two sets of measurements may have been obtained in measuring the same quantity. I venture to think, then, that those who do not agree with methods which involve arguments of inverse probability have no justification for using the ordinary test of the ratio of the difference of the means of two sets of observations to its standard deviation.

FERTILITY OF MARRIAGE AND POPULATION GROWTH.

By L. R. CONNOR, M.Sc.(Econ.).

THE following is a revised and condensed version of a thesis approved for the degree of Master of Science (Economics) in the University of London :—

Introductory.

The object of the paper is to investigate the relationship between fertility of marriage in England and Wales, as measured by average number of births per marriage, and rate of population growth, and the writer has taken as his starting-point the paper "On Marriage-Rates and Marriage-Ages, with Special Reference to the Growth of Population," contributed to the Proceedings of the Society by Dr. Ogle in 1890 (*Journal of the Royal Statistical Society*, vol. liii, pp. 253-280).

Briefly, Dr. Ogle considered the population of England and Wales "was growing in a most formidable manner." Arguing that the average number of children born to a marriage in England and Wales was about 4·2, and that, "so long as the ages at which women married did not materially change, this might be taken as a constant measure of fertility," he found that "if one-quarter of the women who married were to remain permanently celibate, and the remaining three-quarters were to retard their marriages for five years, the birth-rate would be reduced to the level of the current death-rate"; and he concluded that "if the growth of population was hereafter to be arrested, and a stationary condition produced, either by emigration, or by increase of permanent celibacy, or by retardation of marriage, these remedies would have to be applied on a scale so enormously in excess of any experience as to amount to a social revolution."

It will be seen that Dr. Ogle regarded the number of births per marriage as fixed and unalterable, subject to the average age at marriage remaining the same (indeed, he quoted Graunt's *Observations on the*

Bills of Mortality (1665), to the effect that "every wedding, one with another, produces four children"), and that he contemplated no means of restraining the growth of population other than celibacy, emigration, and retardation of marriage. The fall in the birth-rate dates from the 'seventies, and it is somewhat remarkable that Dr. Ogle should not have contemplated the possibility of any reduction in the number of births per marriage, but should have taken the permanency of the figure as axiomatic.

It is now proposed to re-open the subject in the light of modern conditions, taking into consideration on the one hand the improvement in national vitality, and, on the other, the decrease in the fertility of marriage.

"Births per marriage" is a simple and natural measure of fertility to use, and it involves a causal sequence of a direct and intelligible kind. On the other hand it is an "atypical average," and can only be used for comparative purpose with due regard to the changes (if any) that take place in the conditions from which it emerges. Any conclusions reached in this paper must therefore be read with this qualification in mind.

General considerations.

It is clear from the nature of the case that the problem of the relationship between births per marriage and rate of population growth does not admit of solution in general terms. Not only do marriage-rates and remarriage-rates, death-rates and migration-rates vary from year to year, but the existing population constitution has also to be taken into account. On the other hand, there is a presumption that the said variations are, to a considerable extent, uncorrelated with one another, and that if conditions be stabilized by means of averages, actual deviations from these averages will tend on the whole to cancel each other out, so that a fair measure of agreement may be preserved between the results suggested by theory and the results observed in practice. We shall now proceed to the theory of population growth upon this assumption.

A stationary population.

At the outset let us determine the number of births per marriage required under present conditions to keep the population stationary, or approximately so.

In view of the excess of female lives over the whole population range, and of the initiative taken by the man in the matter of marriage, the marriage-rate will be regarded as determined by the

number of marriageable males, and not by the number of marriageable males and females taken jointly. In other words, the chance of marriage for a male will be taken as given, and the chance of marriage for a female will be assumed to adjust itself to correspond with any fluctuations in the ratio between marriageable males and marriageable females.

If p represents the chance of living and getting married for a male aged 0, the number of male births per male married required to replace the births of the year 0 in a generation's time is evidently the reciprocal of p . To find the number of male births per marriage from the number of births per male married, it will be necessary to correct p for the chance of remarriage, viz. :—

$$f = \frac{1}{p(1+d)} \quad \dots \dots \dots I$$

where f represents births per marriage and d represents the remarriage rate.

The chance of living and getting married for a male aged 0 can be determined approximately from the life-table by finding the product-sum of the deaths over quinquennial intervals and the estimated proportions of married and widowed in the corresponding age-groups. This product-sum gives the total number of lives who were married or widowed at time of exit. Using English Life-Table No. 8, and the proportions of married and widowed shown by the Census of 1911, we get the following results :—

TABLE A.—*England and Wales. Estimated number out of 10,000 males born who die married or widowed.*

(1) Age in years (x).	(2) L.	(3) Number of deaths in interval.	(4) Proportion married or widowed (Census of 1911).	(5) Estimated number of deaths of married or widowed males. Col. (3) × col. (4).
0	10,000	1,934	—	—
15	8,046	112	·002	—
20	7,934	147	·143	21
25	7,787	365	·614	224
35	7,422	576	·831	479
45	6,846	945	·878	830
55	5,901	1,549	·902	1,397
65	4,352	4,352	·920	4,004
Totals	—	10,000	—	6,955

No significant difference is made by using the results of the Census of 1921.

On this basis, p (the chance of living and getting married for a male aged 0) is about .695. Making an allowance of 0 per cent. for remarriages, we find the corresponding marriage-rate to be 758 per 1,000 males born, and the number of male births per marriage required to replace each generation as it disappears to be 1.32. Assuming the number of female births bears a constant ratio to the number of male births of 100 : 105, the total number of births per marriage required will be 2.58.

In this calculation illegitimate births have been regarded as transferred to the married population. In order to construct a table of legitimate births per marriage it will be necessary to make an allowance of 4 per cent. for this cause. Thus the 2.58 births per marriage required to keep the population stationary will be supposed to consist of 2.48 legitimate births and .10 illegitimate.

Corresponding calculations have been made for the year 1911 and the intercensal periods 1901-11 and 1891-1911, and the results are summarized as follows :—

TABLE B.—*Births per marriage required to replace each generation as it disappears.*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period.	Chance of marriage for male aged 0 (p).	Remainage rate (d).	Marriage rate per 1 000 born.	Number of male births per marriage required (r).	Total number of births per marriage required	Correction coefficient for illegitimate births.	Total number of legitimate births per marriage required *
		Per cent.					
1911	.695	9.00	758	1.32	2.58	.96	2.48
1901-11	.667	9.41	730	1.37	2.67	.96	2.56
1891-1911	.622	11.6	694	1.44	2.81	.96	2.70

* This figure will be referred to as the "basic number of births per marriage."

In the above calculations it has been implicitly assumed that the successive quotas of births originating from the births of the year 0 are concentrated on the years $g, 2g, \dots$ (where g represents the average interval between birth and paternity). On this basis any initial fluctuations in the number of births (involving idiosyncrasies in future age-distribution) will be preserved in *perpetuum*. In practice the successive quotas of births will be dispersed about their means,

so that if the first quota be spread over an interval with standard deviation σ , the n th quota will be spread over an interval with standard deviation $\sigma\sqrt{n}$. Thus the dispersion of each successive quota of births about its mean increases with \sqrt{n} , and with a constant number of births per marriage any initial fluctuations will gradually disappear, and the annual number of births will tend towards a fixed level.

Where the annual number of births has been fluctuating round a fixed mean for a sufficiently long period, the population will (with constant death-rates) tend to conform to the L_x column of the Life-Table, with radix equal to the average annual number of births. In other words, the population will, under the conditions indicated, tend towards a stationary state.

A moving population.

Let us now consider the typical case where the annual number of births is showing a trend. To simplify matters, it will be assumed that marriage is a function of age alone—i.e. that the chance of marriage (and of remarriage) for a male aged 0, as well as his age at marriage, remains constant. In other words, variations in the annual number of births will be regarded as due to deliberate variations from the basic number of legitimate births per marriage, and not to celibacy or to retardation of marriage, as contemplated by Dr. Ogle.

Following the same line of argument as has been followed in the preceding paragraph with reference to a stationary population, it is clear that, if the basic number of births per marriage be permanently increased in the ratio 1 : R, the number of births that will replace the births of the year 0 in a generation's time will also be increased in the ratio 1 : R, and so on. Taking into consideration what has already been said as to the increasing dispersion of successive quotas of births about their means, it is clear that, whatever may have been its initial movements, the annual number of births will gradually develop a definite upward trend, ultimately settling down to a geometric progression. The common ratio of the progression will be 1 : R per generation. Further, as the population in each age-group is supposed to bear a constant ratio to the number of births from which it originated, the population constitution will ultimately conform to the formula—

$$P_a^b = \sum_{x=a}^{x=b} L_x R^{\frac{t-x}{g}} \quad \text{II}$$

where t represents time in years, and P_a^b represents the population living in the age-groups a to b , inclusive.

In other words, the population, both in general and in detail, will under the conditions indicated follow the law of geometric progression, as suggested by Malthus, and its age-distribution will remain constant from year to year.

If now we can determine the length of a generation (for this purpose the average survivorship of sons over their fathers, or the average interval between birth and paternity), the problem can be solved, subject to the conditions indicated.

The length of a generation is generally taken as $33\frac{1}{3}$ years. This is, however, a rough generalization ascribed to Herodotus, and must not be taken as applicable in the present case. It will be assumed the length of a (male) generation can be determined to a sufficient degree of accuracy by adding to the average age of bridegrooms in England and Wales the average interval between marriage and paternity. The average age of bridegrooms is approximately constant at 29 years. Unfortunately the data for the determination of the average interval between marriage and paternity in general terms are inadequate. By using the fertility rates obtained by the Registrar-General for England and Wales in connection with the Census of 1921, it would be possible to determine this interval for England and Wales at the present day; but we have no certain means of saying how the interval would vary if the average number of births per marriage were appreciably different from its present number.

There is a presumption that the average interval between marriage and paternity will be an increasing function of the number of births per marriage, and in default of anything better the writer has used the figures given by Messrs. Lewis and Lewis in their work upon *Natality and Fecundity*. The figures themselves are derived from the Scottish birth registers for the year 1855:—

TABLE C.—Average interval between marriage and birth of successive children; and average length of a (male) generation according to number of births per marriage.

(1) Order of birth.	(2) Average interval between marriage and births of successive children.	(3) Average interval between marriage and paternity.	(4) Approximate length of a (male) generation. (<i>Smoothed figures in italics.</i>)
	Years	Years.	Years.
1 . . .	1.50	1.50	30.50 (<i>30.3</i>)
2 . . .	3.07	2.28	31.28 (<i>31.3</i>)
3 . . .	5.19	3.25	32.25 (<i>32.3</i>)
4 . . .	7.35	4.28	33.28 (<i>33.3</i>)
5 . . .	9.53	5.33	34.33 (<i>34.3</i>)

By slight adjustments in the last column, the length of a generation can be expressed as a linear function of number of births per marriage within the limits indicated. (*See figures in italics.*) It will be noted that to the traditional 4 births per marriage there now corresponds the traditional $33\frac{1}{3}$ years of a generation.

Upon this basis the relationship between births per marriage and average rate of population growth can be represented by means of the formula

$$I_1 = \left(\frac{B}{B_0} \right)^{\frac{1}{g}} \dots \dots \dots \text{III}$$

where

I_1 represents annual index of population growth.

B represents legitimate births per marriage.

B_0 represents the basic number of legitimate births per marriage.

g represents the length of a generation in years.

Taking logarithms, we have

$$\log I_1 = \frac{1}{g} (\log B - \log B_0) \dots \dots \dots \text{IV}$$

Taking statistical differentials, we have

$$\frac{\delta I_1}{I_1} = - \frac{\delta g}{g^2} (\log B - \log B_0) - \frac{1}{g} \frac{\delta B_0}{B_0} \dots \dots \dots \text{V}$$

In this expression the first term on the right-hand side tends to vanish in comparison with the second, and we have

$$\delta I_1 = - \frac{I_1}{g B_0} \delta B_0 \dots \dots \dots \text{VI}$$

Putting

$$I_1 = 1, g = 33\frac{1}{3}, B_0 = 2.5, \delta B_0 = \pm .25 \text{ (say)}$$

we have

$$\delta I_1 = \pm .003 \text{ (say).}$$

In other words, a small error made in the estimation of the length of a generation may be neglected in comparison with the error made in estimating the basic number of births per marriage and the margin of error in I_1 should not exceed .3 per cent. per annum. An error of .3 per cent. is inappreciable over a short period, but over a long

period the cumulative error is serious. Tabulating Formula III for argument B. we have—

TABLE D.—*Legitimate births per marriage, with corresponding annual and decennial indices of population growth, in the absence of migration. (See Formula III, where $B = 2.48$.)*

(1) Legitimate births per marriage. (B)	(2) Index of population growth per generation. (B/B_0)	(3) Approximate length of a (male) generation. (g)	(4) Annual index of population growth. (I_1)	(5) Decennial index of population growth. (I_{10})
		Years.		
2.0	0.80645	31.3	0.9933	0.9336
2.5	1.0081	31.8	1.0002	1.0025
3.0	1.2097	32.3	1.0059	1.0607
3.5	1.4113	32.8	1.0106	1.1107
4.0	1.6129	33.3	1.0145	1.1543
4.5	1.8145	33.8	1.0178	1.1928
5.0	2.0161	34.3	1.0207	1.2268

The estimated margin of error in col. (4) due to errors in calculating the basic number of births per marriage and the length of a generation is = .0030. It will be convenient to retain the fourth decimal place for purposes of comparison with the observed figures.

From what has previously been said it is clear that these figures strictly apply only in the long run to a population (immune from wars, epidemics, and migration) in which the annual number of births has been in stable geometrical progression with appropriate common ratio for a sufficiently long period.

Considering an actual population, we might expect to find deviations from the theoretical figures due in the first place to annual fluctuations in the various statistical rates, in the second place to secular changes in the same, and in the third place to idiosyncrasies of the population structure (the heritage of its past history) which give it a certain impetus in an upward or downward direction, tending either to reinforce or to override other causes of change.

The observational determination of number of births per marriage.

The question now arises, how far our results are susceptible of verification. The English and Scottish fertility censuses of 1911 give figures representing number of births per marriage, but these only refer to marriages that have come under observation, and no account is taken of comparable marriages dissolved by death of one of the

ERRATUM.

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For $= \frac{h}{2} (50 - t) (51 - t) \quad . \quad . \quad . \quad \text{VIII}$

read $F_t = \frac{h}{2} (50 - t) (51 - t) \quad . \quad . \quad . \quad \text{VIII}$

parties or by separation prior to the date of the census, and some of the tables include marriages of uncompleted fertility.

The classical method of determining number of births per marriage is to divide the annual number of births by the annual number of marriages. An improvement was introduced by Dr. Farr, who divided by the marriages of six years previously, six years representing the (assumed) average interval between marriage and maternity. Since Dr. Farr's time other methods of reckoning fertility have come into vogue, and this particular measure has been dropped.

Dr. Farr's measure is convenient as a summary index of fertility, and the writer has ventured to reintroduce it in a modified form. The births of a given year originate from the marriages of the preceding thirty years in inverse measure to the remoteness of the latter. If then the more remote marriages are weighted down by a system of coefficients based on the fact that fertility is a decreasing function of marriage duration, the weighted average will be a suitable constructive divisor for our purpose. Further, by the theory of weighted averages it is not necessary for the coefficients to be determined with any great degree of exactitude, for when the quantities do not differ greatly in magnitude, errors in the weights can generally be neglected.

Considerations of space prevent the writer from giving his lengthy calculations in detail, and the following summary of his method must suffice.

The issue expected from marriages contracted at central ages $17\frac{1}{2}$, $22\frac{1}{2}$... $42\frac{1}{2}$ was calculated by means of Tait's approximate formulæ (see Matthews Duncan's *Fecundity, Fertility, Sterility, and Allied Topics* (1866)).

The formulæ are :—

$$f_t = k(50 - t) \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{VII}$$

$$= \frac{k}{2} (50 - t) (51 - t) \quad . \quad . \quad . \quad \text{VIII}$$

where

f represents fertility rate (births per 100 marriages).

t represents wife's age in years.

k is a constant appropriate to the particular population under review.

F represents aggregate fertility for a wife married at age t .

The figures were then corrected for the incidence of mortality in the parents, using English Life-Tables No. 6, and the corrected

figures were weighted according to the proportionate frequencies of marriage contracted over the period 1891-1900. As a result, the number of births per marriage expected during the said decennium was found to be 4·10, and the weights applicable to the marriages of the past were determined as under :—

TABLE E.—*System of weights representing the relative contributions of marriages contracted in the past to births occurring in the present.*

(1) Marriages contracted, years ago	(2) 0-5.	(3) 5-10.	(4) 10-15.	(5) 15-20.	(6) 20-25.	(7) 25-30.	(8) Total.
Weight assigned .	·373	·276	·187	·110	·046	·008	1·000

The ratio between the births of the year $t + 1$ and the relevant marriages can then be determined by dividing the births of the year $t + 1$ by the weighted average of the marriages for the six quinquennials ending with the year t .

Applying these weights to the marriages of the years 1860 onwards, the following results are obtained :—

TABLE F.—*Ratio between legitimate births and relevant marriages, 1892-1923.*

(1) Year in which births occurred.	(2) Ratio between legitimate births and relevant marriages.	(3) The same (by Dr. Farr's method).
1892	4·24	4·39
1893	4·28	4·36
1894	4·12	4·18
1895	4·23	4·13
1896	4·16	3·93
1897	4·13	3·89
1898	4·08	3·90
1899	4·06	4·07
1900	3·96	3·94
1901	3·92	3·92
1902	3·92	3·72
1903	3·88	3·66
1904	3·83	3·56
1905	3·72	3·41
1906	3·70	3·50
1907	3·59	3·41
1908	3·63	3·45
1909	3·50	3·36
1910	3·42	3·34

TABLE F—*Contd.*

(1) Year in which births occurred.	(2) Ratio between legitimate births and relevant marriages.	(3) The same (by Dr. Farr's method).
1911 ..	3.31	3.23
1912 ...	3.25	3.09
1913 ..	3.26	3.06
1914* ..	3.20	3.18
1915	2.93	2.98
1916 ..	2.73	2.79
1917 ..	2.29	2.30
1918 ..	2.25	2.19
1919 ..	2.35	2.27
1920 ..	3.21	3.11
1921 ...	2.78	2.24
1922 ..	2.53	2.67
1923 ..	2.44	2.81

* From this point onwards the figures are given for what they are worth.

A practical test.

It will be interesting to test theory by observation. Taking the period 1891-1913, and considering the natural increase of population (excess of births over deaths), we have the following results on applying Formula III:—

TABLE G.—*Births per marriage and rate of population growth, 1891-1913.*

(1) Period.	(2) Ratio between legitimate births and relevant marriages. (From Table F.)	(3) Basic number of births per marriage. (From Table B.)	(4) Index of population growth per generation.	(5) Approximate length of a genera- tion.	(6) Index of annual rate of population growth.	(7) Observed (natural) rate of growth.	(8) Difference col. (7)– col. (6).
				Years.			
1891-1901	4.12	2.70	1.5259	33.4	1.0127	1.0117	– .0010
1901-1911	3.65	2.56	1.4258	32.9	1.0108	1.0119	+ .0011
1909-1913	3.35	2.48	1.3508	32.6	1.0093	1.0104	+ .0011

The percentage rates of growth indicated by cols. (6) and (7) are of the same order of magnitude, but no definite conclusion can be drawn from the differences in col. (8). They are well within the

margin of error postulated, but how far they represent real differences and how far they represent errors in calculation, errors due to rounding-off, etc., must remain a matter of speculation.

A priori a good fit is not to be expected. Rate of population growth depends not only upon the fertility of the present, but also upon the impetus given to the population as a whole by the fertility of the past. Until this impetus has been exhausted and present fertility has, so to speak, taken command of the situation, there must be a divergence between observation and theory. The gap will widen every time a variation takes place in the number of births per marriage; it will narrow in so far as a fall in the number of births per marriage may be compensated for by an improvement in the expectation of life, and hence by an increase in the total population supported by 1,000 births. Thus we have no criterion of the goodness of fit, but the matter must rest with the individual judgment.

It must be remembered that all the figures were arrived at by somewhat sketchy processes, involving the stabilization of quantities known to be variable; that the excess of births over deaths (natural increase of population) is not quite the same thing as population growth as it would have been in the absence of migration; and that the population of England and Wales has not been increasing at a uniform rate, and so does not comply with the strict requirements of theory. On the other hand, the substantial agreement shown over the whole period of two decades between the two sets of figures computed on utterly different bases can scarcely be a matter of pure chance, and it affords, if not a proof, at least a strong presumption, that the theoretical figures are approximately correct.

Conclusion.

The general conclusion reached is that the relationship between births per marriage and rate of population growth is a vague and loose one, but that under stabilized (or at least slowly changing) conditions it is capable of numerical measurement over short periods within a margin of error that may be approximately defined. It is also possible to compute a ratio, births : relevant marriages, according to prescribed rules that gives results which are not inconsistent with theory.

The remainder of the original paper discussed sundry questions arising out of the matter here presented, viz. the future population of Great Britain, the application of the theory to problems of family allowances, birth control, etc., and the corrections necessary to allow

for migration. Considerations of space have, however, compelled the writer to leave these matters out.

The writer does not present his views with any feeling of finality, but he thinks the problem has been pursued as far as is profitable at the present stage. The chief difficulties experienced are due to instability of conditions caused by the war, and to lack of adequate statistical data. Perhaps in a few years' time, when new Life-Tables have been calculated for England and Wales, and further information may be available on the subject of differential fertility rates, it may be worth while taking up the problem again.

Dr. Dublin and Mr. Lotka's contribution to the subject.

The original paper of which this is a condensation had reached the stage of final draft when the writer's attention was drawn to a paper by Dr. Dublin and Mr. Lotka appearing in the *Journal of the American Statistical Association* for September, 1925. This is the first paper, to the writer's knowledge, that has treated the subject comprehensively on modern statistical lines, and it is well worth careful study.

Briefly, the writers find from American experience that if every white female born survived until the age of 55 she would have, on the average, 1·420 daughters, but that the incidence of mortality among the parents reduces this number to 1·168. Actually the births in each generation are spread over a number of years. We may, however, consider them concentrated for each generation at one point of time, successive generations being spread T years apart. There is one particular value of T which will give the same resultant secular rate of increase as that which actually occurs with births in each generation spread over a number of years. The exact value of T involves the solution of a transcendental equation, and leads to the values 28·33 years from mother to daughter and 32·76 years from father to son.

In so far as they present points of contact, this paper and the present writer's are in agreement as to principles and methods, though not always as to numerical result. In particular the following points of interest arise :—

- (i) Dublin and Lotka take the female population as the basic element, whilst the writer takes the male population.
- (ii) The chance of marriage for a female aged 0 is determined at ·785, whilst a calculation by the writer for England and Wales gives ·694.

- (iii) Dublin and Lotka ignore the elements of illegitimacy and remarriages. The writer's calculation of the basic number of births per marriage is 2.58 as against 2.62 by Dublin and Lotka (elsewhere given as 2.60).
- (iv) The length of a male generation is determined deductively at about 32 years, whilst the writer has estimated it empirically at about the same figure on the present basis of 2.5-3.0 births per marriage.

Such divergences of numerical results as occur can well be explained by the difference of character between the American and English populations, and by the instability of conditions and the large margin of error involved in the calculations.

THE GROWTH OF TEXTILE BUSINESSES IN THE OLDHAM DISTRICT,
1884-1924.

By T. S. ASHTON.

THIS paper is to be regarded as a belated appendix to the more elaborate essay on the Sizes of Businesses, read before the Royal Statistical Society in March, 1914. In this an attempt was made to prove statistically the existence of typical or representative magnitudes round which firms tend to range with some measure of regularity; the size-dispersion of businesses in the Lancashire Cotton Industry of 1911 was compared with that of 1884; and the emergence of new types during this period was revealed. It was the intention of the authors to consider in a further paper the process by which the change in the scale of the typical business unit had come about—whether by sudden expansion or evolutionary growth—and preliminary investigations had been made in the Oldham area when the outbreak of war brought other preoccupations.* It is some compensation for the delay that the growth of businesses can now be studied over the longer period of forty years.

The source of information is again the series of Lancashire Cotton Spinners and Manufacturers' Directories issued annually by Messrs. Worrall, of Oldham.† The Oldham district has been selected for investigation because it is by far the largest homogeneous area within the Lancashire industry:‡ in 1884 Greater Oldham possessed 23·3 per cent. of the spindles in the industry, in 1902 26·8 per cent., and in 1924 exactly 30 per cent. The firms here are concerned almost exclusively with the spinning process; § they are

* The author is deeply indebted to Sir Sydney Chapman for suggestions and advice in the early stages of the inquiry.

† Thanks are due to Messrs. Worrall for permission to inspect the early Directories at their offices.

‡ Beside Oldham itself, the area covers Chadderton, Hollinwood, and Middleton Junction; Crompton and Shaw; Lees, Grotton, Hey, and Springhead; and Royton.

§ In 1884, of 231 firms for which particulars are given, 201 were purely spinning concerns, 3 purely weaving, and 27 combined both processes. In 1924 the total of 218 was made up of 203 spinning, 4 weaving, and 11 combined undertakings.

largely of the joint-stock form; and the similarity of their size-distribution to that of all spinning businesses in Lancashire—remarked upon in the earlier paper—renders it probable that any broad generalizations drawn from this area will carry some measure of truth if applied to the spinning branch of the industry as a whole.

The term “business” is again used to indicate “any productive group or groups functioning under one direction in a district”; but as there are relatively few firms in Greater Oldham which also own factories outside the region, the figures would have been but slightly different if a wider definition had been adopted. In the reconstruction and recapitalization boom of 1919–20, a number of previously autonomous businesses were brought under a single control. Where the fusion was so complete that the names of the absorbed firms disappeared from the Directories the combination has been treated as a single firm; but where the owners of a combine continue to register a constituent undertaking in its original name, it is argued that some measure of individuality has been preserved, and the undertaking is treated in this paper as a separate business.

For the present purpose it has been considered sufficient to measure the sizes of businesses every third year from 1884 to 1914, and from 1918 to 1924. The explanation of the four-years’ gap, 1914–18, is partly that the 1917 Directory was less easy of access than that for 1918, partly that it seemed sound to isolate the war years, and partly that the arrangement gave as the next triennial period the years 1918–21, which covered the rise and decline of the post-war boom.

Table 1 and the diagram constructed from it give an immediate answer to the question that prompted the inquiry: it is evident that the change from the relatively small representative firm of 1884 to the larger type of 1924 is the result, not of a sudden jump, but of gradual growth.

The graph for 1884 is clearly bi-modal. There is a dominant peak at 10–20 thousand spindles, and a somewhat lower peak at 70–80 thousand spindles; the table-land between the two may be regarded as compounded of the easterly slope of the one eminence, so to speak, and the westerly slope of the other. The businesses with less than 20,000 spindles consist of: (a) Firms engaged, partly or wholly, in the process of doubling: 8 of the 27 businesses in the 0–10 thousand group are classified in the Directory as doublers, and 8 of the 47 in the 10–20 thousand group engaged in the process either exclusively or along with spinning. (b) Firms engaged in spinning, but of the private or partnership type: only 1 of the 27

businesses in the 0-10 thousand spindles class, and 7 of the 47 in the next class, are limited companies.

During the three years 1884-7 a considerable increase takes place in the number of firms with spindles not exceeding 10,000, and of the 40 businesses in this group in 1887 no fewer than 21 are doublers. Thereafter an almost unbroken fall occurs in the group, as well as in the next larger one, but a minor peak at 10-20 thousand spindles persists throughout the forty years. Of the 19 firms with spindles not exceeding 20,000 in 1924, 13 are specified as doublers, and the remainder are engaged in special work, such as the spinning of waste. The ordinary spinning firms of 1884 in these classes have obviously ceased to exist or have passed to higher classes.

Concurrent with this denudation at the lower end of the scale is the thrusting up of peaks further along. Generally, the number of firms of all magnitudes below 50,000 spindles falls, and that of magnitudes above 80,000 spindles rises, progressively during the forty years. The peak at 70-80 thousand spindles, visible in 1884, grows till it reaches a maximum of 31 businesses in 1899. Nine years later it is superseded by the 90-100 thousand spindles group, and this in turn is overtopped in 1914 by a new type at 100-110 thousand spindles, which remains dominant to the end of the period.

The connection between the emergence of these larger types and the steady extension of the joint-stock form of organization is revealed in Table I: the all but universal adoption of the company form probably explains why the graphs for the later years approximate more closely than those of earlier years to the normal curve of error.*

So far, what has been presented is a series of photographs of a growing industry in which certain seeming types stand out. But these seeming types are not necessarily true types. The prominence of any one of them may clearly be due to the rapid sinking of, say, a smaller type and the incomplete growth of a type that is taking its place and that happens to be larger than the seeming type. Thus, suppose that in two consecutive periods the numbers of firms of three different magnitudes are as follows :—

	70-80 thousand spindles	80-90 thousand spindles	90-100 thousand spindles
First period	50	30	10
Second period	30	50	45

* It has not been thought worth while to distinguish between those companies that have grown out of private concerns and those that were founded on a joint-stock basis—between the C.'s and the J.'s of the earlier paper.

If the second period were considered in isolation, 80-90 thousand spindles might be regarded as the type. But evidently it is only the seeming type; the true type is 90-100 thousand spindles, for this is the group in which the number of firms has grown most.* The distinction is brought out in Table II, where the columns headed A show the size-distribution of businesses, and those headed C the change in the number of firms of each size as compared with three years previously. Generally the seeming type is also the true type; but in 1905, 1908, and 1911 the representative firm—in the sense of that type the number of which is increasing most—is somewhat larger than the seeming type exhibited in column A.

A further question arises as to the manner in which new types arise. Is the increase in scale of the representative firm as the period advances due to the creation of new firms of typical magnitude, or is it due to the growth of smaller firms into larger? Table III attempts an answer to this question. Columns C again indicate the changes in the magnitude of businesses, but this time over periods of six years. In columns B are shown the sizes of those firms whose names were not in the Directory for the first year of each six-year period—say, 1884—but were in that for the last—say, 1890. Column B in any period thus presents the size-dispersion of businesses at or near birth—of babies or beginners in the industry. When a business has merely added “Ltd.” to its title, it has not been treated as a new concern; and in other cases there is often Directory evidence which enables one to trace a business over the years, in spite of a change of name, such as that occasioned by a dissolution of partnership or the adoption of an impersonal joint-stock title. In such cases the firm for our purpose remains the same.

Columns D exhibit the size-distribution of firms whose names appeared in the Directory for the first year, but not in that for the last year of each period. They indicate, therefore, the sizes of those businesses that disappeared or “died” during each period. If we deduct the figures in column D of any period from the corresponding figures in column B, we get numbers, positive or negative, indicating the excess of “births” over “deaths” for each size-group; and if these numbers, in turn, be subtracted from the corresponding figures in column C, we have an indication of the extent to which the change in the scale of all firms is due to the growth or shrinkage of businesses other than those which begin or disappear during the period. Columns R show such remainders.

* The importance of distinguishing between the seeming type and the true type was stressed by Professor Edgeworth, *Journal of the Royal Statistical Society*, lxxvii, p. 554.

Thus: $R = C - (B - D)$. The figures indicate, let it be repeated, the modification of the size-distribution of businesses effected by the removal of some businesses from one size-group to another.

On inspection of the columns headed B, two movements of interest are seen. Between 1884 and 1890 there took place a large creation of new firms with spindles not exceeding 10,000—many of them, as already mentioned, specialized to the process of doubling. And between 1902 and 1908 there was a similar bursting forth of new enterprises, the normal size of which was 90-100 thousand spindles. In no other period were the births sufficiently numerous to reveal a type, and the only feature worthy of note is the wide range in the sizes of beginners in all periods. Mortality, on the other hand, is largely concentrated on the smaller firms, for businesses that are born small, like human beings, must usually either grow or cease to exist. During the thirty-four years from 1884 to 1918 only 3 firms with spindles exceeding 80,000 disappeared; and, though the effect of the boom and subsequent depression of 1918-24 was to add 7 more of these large firms to the number, it must be remembered that mortality, in our sense, does not mean physical death, or even necessarily the dissolution of the organization of a business; some of these 7 disappearances undoubtedly represent absorptions or amalgamations with other undertakings.

The columns headed R also reveal facts deserving comment. In the 1884-90 period the increase in the lowest group shows that 2 businesses of a size exceeding 10,000 spindles in 1884 had less than this number in 1890. Contrary to expectation, such diminution in the size of a firm is by no means uncommon; it can be observed in the lowest group again in 1908-14 and 1914-18. A moderate shrinkage is, indeed, the frequent, though not invariable, portent of ultimate disappearance, like the bowing of the human frame in old age.

It has been shown that the increase in the modal size between 1902 and 1908 was due mainly to the creation of new firms, especially, it is clear, during and following the boom of 1907. But in all other periods the increase in typical scale must be attributed in greater measure to the growth of existing businesses of moderate size and the elimination of very small businesses. In particular, the transference of 7 firms from the 50-60 thousand spindles group in 1884-90 largely explains the increase in the number of businesses of greater magnitude; and in 1902-8, and again in 1908-14, a removal of 7 firms from the 70-80 thousand group contributed to the rise of the larger type. As the net result of all causes, there were 13 more firms in the 100-110 thousand spindles group in 1914 than in

1908, and 11 of these were the result of removal from other groups. Throughout the forty years, the largest concerns of all—those exceeding 160,000 spindles—are entirely the product of transference, and not of sudden creation.

The effect of mortality and growth, disentangled from that of the birth of new firms, can be observed in Table IV, which shows the size-dispersion at different periods of the businesses existing in 1884. The rapid elimination of small firms is again illustrated. Movement of businesses into a higher class is not evident until the 30-40 thousand spindles class is reached in 1890; it is marked in most of the classes above 80,000 spindles, especially in the 80-90 thousand spindles group between 1884 and 1918; and even where it is not visible, it is probable that some reinforcement has taken place which has been obscured by upward movements from the group, as well as by retirements. Some of the largest businesses in 1924 are veterans, born before 1884; but evidently it is in the 60-70 thousand, 70-80 thousand, and 80-90 thousand spindles groups that the older firms predominate. The 100-110 thousand spindles peak in the graph is quite obviously made up of business units belonging to a later generation.

Table V traces the changes in size of the 68 undertakings that were in continuous existence during the whole forty years. Again, it should be borne in mind that the figures represent only the resultants of constant movements: during every period some businesses increased and others decreased in size, but the 70-80 thousand spindles firm is the mode in every year except 1918. The only other generation of businesses large enough to justify separate examination is that which came into being in 1902-8. The life-history of the 50 concerns in this group is portrayed in Table VI, which shows a movement of the mode from the 90-100 thousand to the 110-120 thousand spindles group, and a growth of numbers in the highest classes; the four largest businesses of all in 1924 had their origin between 1902 and 1908.

The picture of the growth of an industry outlined here recalls a well-known passage in which Dr. Marshall compared business undertakings with the trees of the forest; and other biological analogies spring so readily to the mind that it may be more useful to point out the differences, rather than the similarities, between the life-history of businesses and that of plants, or animals, or men. Businesses are by no means always small at birth; many are born of complete or almost complete stature. In their growth they obey no one law. A few apparently undergo a steady expansion, and the

increment of spindles may be anything from a few hundreds to tens of thousands. With others, increase in size takes place by a sudden leap, which occasionally, but not invariably, synchronizes with a change of organization, such as that implied by the adoption of limited liability, or an alteration of title from a personal to an impersonal form. With yet others, growth is followed by decline, and this, in turn, by new growth. In some cases expansion comes by a widening of the shell of a single organism, in other cases by the absorption of one organism by another. Again, some businesses die by wasting away, and others go down catastrophically when their powers, expressed in spindles, are at their height.

A final word may be added in explanation of the variation from period to period in the numbers of firms entering and leaving the industry. Expressed in the form of a birth-rate per cent. of the businesses already in the industry, the entrants were as follows:—

1884-90.	1890-6.	1896-1902	1902-8.	1908-14.	1914-18.	1918-24.
19.9	11.3	11.0	29.1	8.4	1.9	13.6

One would expect the foundations of new businesses to be laid during periods of prosperity, though the impossibility of increasing new appliances very rapidly would mean that many would not be fully at work until the succeeding period of depression. The six-year periods are not appropriate to a close study of the relations between the trade cycle and the genesis of businesses, and in any case the numbers are somewhat small to warrant very definite conclusions; but as far as the figures go, there is broad confirmation of one's expectations. The birth of 40 new undertakings between 1884 and 1890 reflects the prosperity of the late 'eighties, which culminated in the trade boom of 1889-90; and no fewer than 50 new businesses—many of substantial size—saw the light in the period which included that year of unprecedented profits, 1907. The post-war boom, as is well known, took the form of a change in the ownership of existing concerns; costs of construction and equipment were too high to allow of the erection of many new factories, and only 27 "births" are recorded between 1918 and 1924.

Retirements, on the other hand, show no such tendency to concentration. Expressed in the form of death-rates per 100 firms, they are:—

1884-90.	1890-6.	1896-1902.	1902-8.	1908-11.	1914-18	1918-24.
23.4	17.5	15.4	12.8	5.4	6.7	11.1

Here the striking feature is the steady fall in the pre-war years ; the slight increase in the rate since 1914 can readily be explained by war conditions and by amalgamation of businesses during the years 1918-21. The low rate for 1908-14, in particular, is surprising, in view of the high birth-rate of the preceding period, for one would expect mortality to be specially great among the young in years of depression. The explanation of the progressive fall in mortality would appear to lie in the progressive growth in the scale of businesses which marks the whole period ; it is in accord with Professor Edgeworth's remark as to the greater stability of large businesses,* and with Marshall's observation that " vast joint-stock companies . . . often stagnate but do not readily die."†

* *Papers relating to Political Economy*, vol. 1, p. 84.

† *Principles of Economics*, 7th edition, p. 316.

TABLE I.—*Number of firms (distinguished by size and type*) in Oldham and district.*

Spindles, in thousands.	1884.			1887.			1890.			1893.			1896.			1899.			1902.		
	1884.		T.	1887.		T.	1890.		T.	1893.		T.	1896.		T.	1899.		T.	1902.		T.
	P.	J.		P.	J.		P.	J.		P.	J.		P.	J.		P.	J.		P.	J.	
0—2.5....	3	—	3	6	—	6	6	—	6	5	—	5	2	—	2	2	—	2	2	—	2
2.5—5....	6	—	6	11	—	11	9	—	9	6	—	6	5	—	5	4	—	4	4	—	4
5—7.5....	7	—	7	11	—	11	5	—	5	3	—	3	3	—	3	3	—	3	3	—	3
7.5—10....	10	1	11	12	2	14	10	1	11	11	2	11	10	1	11	—	—	—	1	—	—
10—15....	20	2	22	16	3	19	12	3	13	11	3	13	8	2	10	—	—	—	1	—	—
15—20....	20	5	25	16	3	19	12	2	10	12	3	9	8	2	10	—	—	—	1	—	—
20—25....	11	2	13	11	1	12	7	3	10	6	6	9	5	6	11	3	5	7	5	5	7
25—30....	30	2	32	6	2	8	8	4	12	6	6	12	4	4	11	4	3	8	4	3	8
30—35....	7	5	12	7	—	7	6	—	6	5	—	5	4	7	5	4	3	6	4	2	6
35—40....	5	—	5	7	5	12	7	6	13	5	7	12	4	4	11	2	2	9	2	1	4
40—45....	6	4	10	7	2	9	5	3	8	6	6	9	4	4	6	3	5	7	2	6	7
45—50....	3	2	5	3	5	7	2	5	7	1	1	5	1	1	5	2	2	7	1	4	5
50—55....	6	6	12	2	7	9	5	6	11	4	4	12	4	4	11	2	2	9	1	4	5
55—60....	9	9	18	7	8	15	4	16	20	3	16	19	4	4	22	5	5	21	15	6	10
60—65....	4	12	16	5	14	19	6	17	23	4	24	28	4	4	28	3	3	31	20	29	20
65—70....	6	15	21	7	18	25	6	17	23	4	9	10	1	1	8	—	—	10	11	11	11
70—75....	1	1	2	—	7	7	1	6	7	1	8	8	—	—	9	—	—	13	11	13	13
75—80....	—	4	4	1	3	4	—	6	6	—	4	4	—	—	4	—	—	5	5	5	5
80—85....	—	3	3	—	4	4	—	3	3	—	4	4	—	—	4	—	—	6	1	—	—
85—90....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
90—95....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
95—100....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
100—110....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
110—120....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
120—130....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
130—140....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
140—150....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
150—160....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
160—170....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
170—180....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
180—190....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
190—200....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
200—Over 200....	—	3	3	—	4	4	—	4	4	—	4	4	—	—	4	—	—	6	—	—	—
Total	127	74	201	130	79	209	107	87	194	88	111	199	74	108	182	56	121	177	116	58	174

* P indicates private business or partnerships; J, joint-stock company; and T, total.

TABLE I—Contd.

Spindles, in thousands	1905			1908			1911.			1914.			1918.			1921.			1924		
	P.		T.	P		T.	P.		T.	P		T.	P		T.	P		T.	P		T.
	J			J			J			J			J			J			J		
0— 2.5	2	2	2	1	2	2	2	1	3	1	1	2	1	1	2	1	1	1	1	1	1
— 5	3	3	3	2	1	1	2	1	1	1	2	3	1	1	2	—	2	2	—	2	2
— 7.5	3	3	3	1	2	2	7	1	3	1	—	3	1	1	2	1	1	1	1	1	1
— 10	10	10	10	8	9	9	2	6	9	6	5	6	3	3	6	3	6	5	3	6	7
— 15	2	4	6	5	8	8	2	6	8	2	4	7	2	2	7	4	2	4	2	2	4
— 20	2	5	7	3	9	9	1	4	5	1	4	5	3	3	8	2	4	4	3	4	3
— 25	3	4	7	2	4	5	2	3	6	1	4	4	1	1	7	—	—	—	—	—	4
— 30	3	4	7	1	5	7	1	4	4	—	4	4	—	—	4	2	4	4	—	—	4
— 35	1	4	5	2	7	7	—	4	4	1	—	4	—	—	6	3	4	4	—	—	4
— 40	3	4	7	2	4	7	1	4	8	1	—	7	—	—	4	3	4	4	—	—	4
— 45	1	6	6	2	5	6	1	5	5	2	—	7	—	—	4	3	7	7	—	—	4
— 50	1	5	6	2	5	6	1	5	6	2	—	7	—	—	5	7	7	7	—	—	7
— 60	2	11	13	13	14	14	2	13	15	10	11	11	2	12	14	11	11	11	11	11	11
— 70	2	15	17	17	19	19	1	17	18	21	22	22	1	16	17	19	19	17	17	17	17
— 80	3	25	28	22	24	24	2	21	23	16	18	18	1	16	17	16	16	16	19	19	19
— 90	1	16	17	19	19	26	—	22	22	22	22	22	—	22	22	22	22	22	20	20	20
— 100	—	19	19	26	26	26	—	26	26	20	20	22	—	20	22	18	18	16	16	16	16
— 110	—	6	6	13	13	12	—	18	18	26	26	22	—	22	20	26	26	26	26	26	26
— 120	—	6	6	4	4	15	—	15	15	14	14	16	—	16	16	13	13	13	13	13	13
— 130	—	6	6	4	4	3	—	3	3	6	6	7	—	7	7	7	7	8	8	8	8
— 140	—	4	4	4	4	4	—	4	4	8	8	9	—	9	9	8	8	9	9	9	9
— 150	1	2	2	1	3	4	1	3	3	1	1	3	1	2	4	6	6	6	7	7	7
— 160	1	1	2	1	1	2	—	2	2	3	3	3	—	3	2	3	3	3	3	3	3
— 170	—	1	—	—	—	1	—	1	1	1	1	1	—	1	1	1	1	1	1	1	1
— 180	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
— 190	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
— 200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Over 200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	42	141	183	33	169	202	27	184	211	24	184	208	18	180	198	9	195	204	5	198	203

SIZE-DISTRIBUTION OF BUSINESSES IN GREATER OLDHAM.

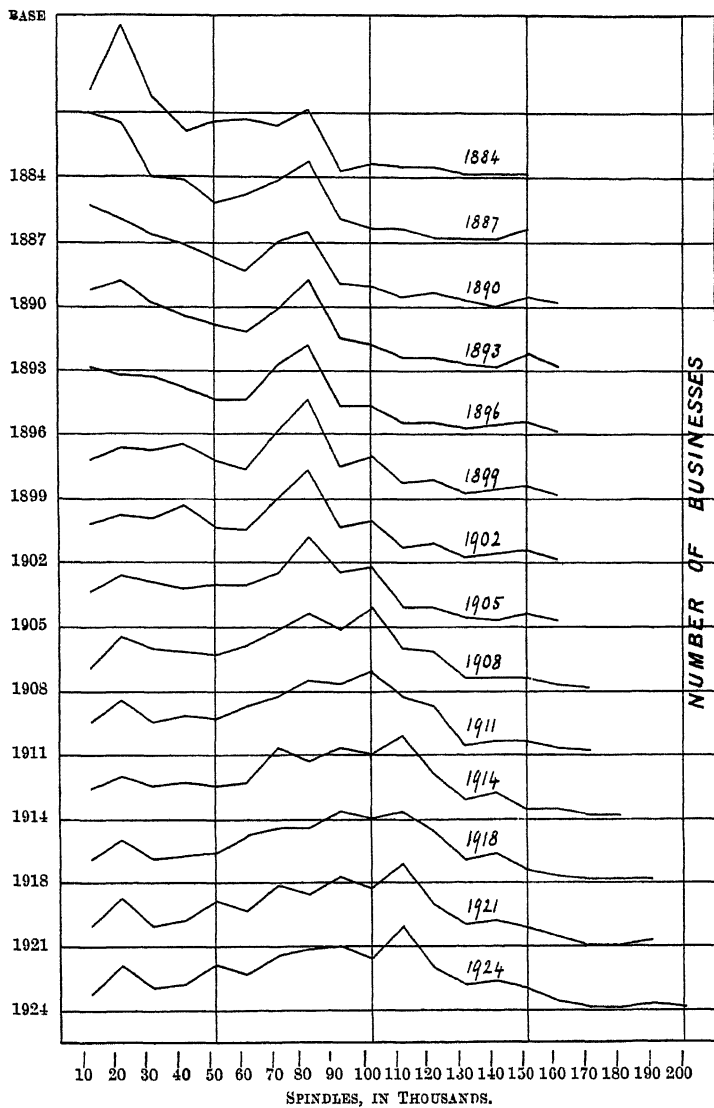


TABLE II.—*Sizes of businesses (columns A) and increases or decreases of numbers of businesses of each size (columns C).*

Spindles, in thousands.	1887.		1890.		1893.		1896.		1899.		1902.		1903.	
	A.	C.	A.	C.	A.	C.	A.	C.	A.	C.	A.	C.	A.	C.
10...	40	+ 13	31	9	25	6	21	4	12	—	9	—	11	1
20...	37	— 10	27	— 10	28	1	19	— 9	16	—	3	—	16	—
30...	20	— 5	22	— 2	21	1	18	— 3	15	—	3	—	14	—
40...	19	+ 4	19	—	17	2	16	— 1	17	—	1	—	12	6
50...	12	— 4	15	— 3	14	1	11	— 1	12	—	1	—	13	—
60...	15	— 3	11	+ 4	12	1	11	— 1	9	—	2	—	13	—
70...	19	+ 3	20	— 1	19	1	22	— 1	21	—	1	—	17	—
80...	25	+ 4	33	— 2	28	5	28	— 3	31	—	3	—	28	—
90...	7	+ 5	7.	—	10	3	9	— 1	10	—	1	—	17	—
100...	4	—	6	+ 2	8	2	9	+ 1	13	—	4	—	19	—
110...	4	+ 1	3	+ 1	4	1	4	—	5	—	1	—	6	—
120...	1	—	4	+ 3	4	—	4	—	6	—	2	—	6	—
130...	1	—	2	+ 3	2	—	2	—	2	—	—	—	3	—
140...	1	—	2	+ 1	4	1	3	—	3	—	—	—	2	—
150...	4	+ 3	3	— 1	5	2	4	+ 1	4	—	—	—	4	—
160...	—	—	1	— 1	1	—	1	—	1	—	—	—	2	—
170...	—	—	—	—	—	—	—	—	—	—	—	—	—	—
180...	—	—	—	—	—	—	—	—	—	—	—	—	—	—
190...	—	—	—	—	—	—	—	—	—	—	—	—	—	—
200...	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Over 200 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	209	+ 8	194	— 15	199	+ 5	182	— 17	177	—	5	—	183	+ 9

TABLE II—*Contd.*

Spindles, in thousands.	1908.			1911.			1914.			1918.			1921.			1924.		
	A.	C.		A.	C.		A.	C.		A.	C.		A.	C.		A.	C.	
10	7	4	—	10	+	3	9	—	1	7	—	2	6	—	1	5	—	1
20	17	1	+	17	—	—	13	—	4	13	—	—	15	+	2	14	—	1
30	13	1	—	10	—	3	10	—	—	7	—	3	6	—	1	7	—	1
40	12	—	—	12	—	—	11	—	1	8	—	—	8	—	—	8	—	—
50	11	2	—	11	—	—	10	—	—	9	—	—	14	—	—	14	—	—
60	14	1	+	15	—	—	11	—	—	14	—	—	11	—	—	11	—	—
70	19	2	+	18	—	—	22	—	4	17	—	5	19	—	—	17	—	—
80	24	4	—	23	—	—	18	—	—	17	—	1	16	—	—	19	—	—
90	19	2	+	22	—	3	22	—	—	22	—	—	22	—	—	20	—	—
100	26	7	+	26	—	—	20	—	6	20	—	—	18	—	—	16	—	—
110	13	7	+	18	—	5	26	—	8	22	—	4	26	—	—	26	—	—
120	12	6	+	15	—	3	14	—	—	16	—	2	13	—	—	13	—	—
130	4	1	+	3	—	1	6	—	+	7	—	1	7	—	—	8	—	—
140	4	2	+	4	—	—	8	—	+	9	—	1	8	—	—	9	—	—
150	4	—	—	4	—	—	3	—	+	4	—	1	6	—	—	7	—	—
160	2	—	—	2	—	—	3	—	+	2	—	1	3	—	—	3	—	—
170	1	1	+	1	—	—	1	—	+	1	—	—	1	—	—	1	—	—
180	—	—	—	—	—	—	1	—	+	1	—	—	1	—	—	1	—	—
190	—	—	—	—	—	—	—	—	—	1	—	—	2	—	—	2	—	—
200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Over 200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Total	202	+ 19		211	+	9	208	—	3	198	—	10	202	+	4	203	+	1

TABLE III—*Contd.*

Spindles, in thousands.	1902-8.				1908-14.				1914-18.				1918-24.			
	C.	B.	D.	R.	C.	B.	D.	R.	C.	B.	D.	R.	C.	B.	D.	R.
10	5	2	3	4	4	4	3	+1	-2	-3	3	+1	-2	2	3	1
20	+2	4	4	1	-	1	2	-2	-3	-	4	+1	+1	3	1	1
30	-1	5	5	3	3	1	1	-1	-3	-	3	-	-	2	2	-
40	-6	2	1	1	-	-	-	-1	-3	-	2	-	-	2	2	-
50	-	2	1	3	-	-	-	-3	1	-	-	-	-	5	1	2
60	+4	2	2	1	3	1	1	+3	+3	-	-	+3	+3	1	2	4
70	-1	2	2	7	-	1	-	-1	5	-	1	-	-	2	2	1
80	-5	3	1	3	6	1	-	+7	1	-	-	-1	+2	2	2	3
90	+8	5	-	7	3	-	-	-3	-	-	-	-	+2	1	2	2
100	+13	12	-	1	6	2	-	-8	-	-	-	-	-4	1	1	4
110	+8	3	-	5	13	2	-	+11	-4	-	1	-3	+4	-	2	6
120	+6	6	-	1	+2	2	-	+2	+1	-	-	+2	+3	-	4	3
130	+2	1	-	-	+2	4	-	+4	+1	-	-	+1	+1	1	-	1
140	+1	1	-	-	+1	-	-	+1	+1	-	-	+1	+1	3	1	2
150	-	-	-	1	-	1	-	-	-	-	-	-	-	1	-	-
160	+1	-	-	1	+1	-	-	+1	-	-	-	-	+1	1	-	-
170	+1	-	-	-	-	-	-	-	-	-	-	-	+1	-	-	-
180	-	-	-	-	-	-	-	-	-	-	-	-	+1	-	-	-
190	-	-	-	-	-	-	-	-	-	-	-	-	+1	-	-	1
200	-	-	-	-	-	-	-	-	-	-	-	-	+1	-	-	1
Over 200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	+28	50	22	-	+6	17	11	-	-10	4	14	-	+5	27	22	-

TABLE IV.—*Size-dispersion at different periods of the businesses existing in 1884.*

Spindles, in thousands.	1884.	1890.	1896.	1902.	1908.	1914.	1918.	1924.
10	27	16	9	6	5	4	2	1
20	47	19	13	7	4	2	2	3
30	25	18	13	8	4	3	3	—
40	15	19	14	12	6	5	3	4
50	17	12	8	7	6	5	6	4
60	18	10	9	7	7	6	9	5
70	16	16	14	15	14	13	10	10
80	21	20	21	18	15	11	10	11
90	2	3	4	4	8	9	12	7
100	4	5	5	6	5	6	5	5
110	3	3	2	2	3	7	6	6
120	3	3	2	5	3	3	2	1
130	1	2	1	2	1	—	1	2
140	1	—	1	2	2	3	3	2
150	1	3	5	4	4	2	3	3
160	—	1	1	1	2	3	2	2
170	—	—	—	—	1	1	1	1
180	—	—	—	—	—	1	1	1
Total	201	150	122	106	90	84	81	68

TABLE V.—*Size-dispersion at different periods of businesses in being from 1884 to 1924.*

Spindles, in thousands.	1884.	1890.	1896.	1902.	1908.	1914.	1918.	1924.
10	1	1	—	—	—	—	—	—
20	4	1	2	2	2	2	2	3
30	5	5	4	—	—	1	1	—
40	4	5	5	6	5	4	3	4
50	7	6	6	6	6	5	5	5
60	12	7	5	6	7	6	9	5
70	9	12	11	12	10	10	8	10
80	16	17	19	17	13	10	9	11
90	1	2	3	3	9	8	10	7
100	3	4	4	4	3	5	5	6
110	2	2	1	2	3	6	5	6
120	1	2	2	4	2	2	2	1
130	1	1	—	—	—	—	—	1
140	1	—	1	2	2	3	2	2
150	1	3	5	4	4	2	3	3
160	—	—	—	—	1	2	2	2
170	—	—	—	—	1	1	1	1
180	—	—	—	—	—	1	1	1
Total	68	68	68	68	68	68	68	68

TABLE VI.—*Size-dispersion at different periods of businesses born 1902-8.*

Spindles, in thousands.	1908.	1914.	1918.	1924.
10	2	1	—	—
20	4	4	4	3
30	5	3	1	2
40	2	1	1	—
50	2	2	1	1
60	2	1	2	2
70	2	3	2	1
80	3	2	1	1
90	5	4	3	2
100	12	6	5	5
110	3	9	6	7
120	6	5	8	8
130	1	4	5	3
140	1	2	2	2
150	—	—	—	—
160	—	—	—	—
170	—	—	—	—
180	—	—	—	—
190	—	—	1	2
200	—	—	—	1
210	—	—	—	—
220	—	—	—	—
230	—	—	1	1
Total	50	47	43	41

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*An Introduction to Statistical Methods*. By Horace Secrist, Ph.D. xxxii + 584 pp. New York: The Macmillan Company, 1925. Price 16s.

This is a revised edition of a text-book on Statistical Methods, written in 1917, which made the author known on both sides of the Atlantic. The present edition is a much-enlarged improvement on the original, and a good deal of the matter is new. It is inevitable with a book of this size that variation in quality should appear, and one realizes when going through the book that, roughly speaking, the first half is better than the second half. This may partly be due to the fact that the majority of books of this kind do not contain what corresponds to Professor Secrist's first half—viz. a general discussion of the objects and methods of statistical inquiry, the different kinds of statistical data available,

the collection and classification of data, and so on; and one is so pleased to read the unusual matter in the first chapters of his book that the second part suffers by contrast.

The book is primarily a text-book for students in schools of commerce, and naturally the illustrations are mostly with reference to economic and business inquiries. The methods of dealing with statistical data are elementary, and do not involve much mathematics, and the book can easily be read by the non-mathematical. The discussion is very full, and should readily be understood by the careful reader.

The book is well illustrated throughout with numerous diagrams and tables; some of the latter may possibly be altered with advantage in a new edition. Each chapter contains a useful bibliography. The chapters on Index-numbers and on the various American Index-numbers of Price, Quantity and Business Conditions are very useful. In the Appendix there is given a table of Powers. Roots and Reciprocals, very useful when making calculations.

The author has spared no pains in his effort to make the various ideas of averages, groups, correlation, etc., comprehensible to the beginner, and the book should prove extremely useful to a wide class of reader.

E. C. R.

2.—*Handbook of Mathematical Statistics*. II. L. Rietz, Editor-in-Chief. viii + 221 pp. Boston: Houghton Mifflin Company, 1924. Price \$4.

This book consists of twelve short chapters, each complete in itself, by various authors, where various mathematical formulæ with illustrative examples are given, the subjects dealt with being the various branches of statistics which crop up in many investigations.

One feels that the mathematical statistician, when reading the book, would realize that only results in general are given, and that the arguments and proofs are left out, but he would be pleased to remember that here is a book to which he can turn for various interpolation formulæ, approximation formulæ for gamma functions, etc., which he can never remember, and which he always has to hunt through papers to find. The non-mathematical statistician, if he were not immediately overcome by the formulæ which occur on nearly every page, would understand, perhaps, if he dipped into the book and was winged from Interpolation, Summation and Graduation, *via* Curve Fitting and Sampling, through Correlation, simple and complicated, to Periodogram Analysis and Index-numbers, what a great deal there is in statistics. He would probably find the chapters on Time-series and Index-numbers the most interesting, and should find the bibliography at the end of the book useful.

The book is essentially a book of reference.

E. C. R.

3.—*Population Problems in the United States and Canada*. Edited by Louis I. Dublin. 318 pp. Publication No. 5 of the Pollak Foundation for Economic Research. Boston and New York: Houghton Mifflin Co., 1926. Price \$4.00.

The Natural Increase of Mankind. By J. Shirley Sweeney, M.A., M.D., D.Sc. 185 pp. Baltimore: The Williams & Wilkins Co., 1926. Price 18s. net.

The first of these books consists of an "outgrowth of papers" (the Preface is responsible for the expression) presented at the annual meeting of the American Statistical Association in 1924, and is made up of contributions from some twenty authors. The object of publishing in book form, the Editor says, is a "hope that these papers may be instrumental in replacing the prevailing unscientific and almost arrogant attitude [towards population problems] with a spirit of scientific investigation." With this purpose in mind, the various authors contributing have produced a book which will repay close attention by the "lay" reader, and, though only in a few cases is the matter or treatment very novel in character, the technical worker will find plenty of matter to interest him.

The subjects discussed include urbanization, optimum size of population, agricultural and mineral resources, and labour supply, while considerable attention is paid to immigration.

It is admitted in the Preface that, wisely, no attempt is made to reconcile conflicting views held by the various authors so that the reader can have both "pros and cons" before him. It seems the more pity that some opinions should be put so dogmatically. To quote an instance, with reference to birth-control it is stated (p. 9) that "in no other way can we account for the rapid decline in the birth-rate in the United States and other countries." No reference is made anywhere to the possibility of cyclical variations in birth-rates, and no detailed attention is paid to the underlying biological and economic reasons that produce birth-control—for, when all is said and done, the latter is only a means and not a cause.

Again, it is easy to dismiss, as does one writer, Raymond Pearl's experiments with a reference to "flies in a fruit jar" (p. 75). It is not so easy to replace his originality; and schemes for "a policy which will secure such adjustment between population and natural resources as will enable us to live as well as possible" (p. 65) scarcely seem convincing. Natural increase or decrease of population may be controlled by biological laws or by economic laws; it is not likely to be affected by the schemes of politicians—or even statisticians.

Dr. Sweeney is under no illusion. It is true that he suggests an international agreement to control numbers, a "league of stationary populations," but at the same time it is his opinion that "man's efforts affect but little the steady secular trend of evolution." He puts forward this first suggestion because he believes that "most of the larger nations are now crowding closely the stage of relative over-population" (i.e. relative to their potential agricultural ability), and that if the present rate of increase continues "all

nations must gradually become dependent upon outside food sources." He reaches these conclusions through a comprehensive study of the rates of increase throughout all the countries of the world possessing statistical data. For rate of increase he employs Pearl's "vital index" (100 births/deaths). His discussion of this statistical constant does not entirely convince one that it is superior to the, perhaps, simpler concept of percentage natural increase.

He sets out the vital indices for each country year by year, studies their mean values and variation (for example, in relation to geographical location), their rates of increase or decrease, and their trend in relation to their magnitude at certain points.

Inquiring into the effects of war and epidemics he finds that "the birth-death ratios, although extraordinarily lowered during the war and influenzal years, resumed their pre-war and pre-influenzal levels within two years' time," and concludes therefore that "war and pestilence serve only to cause a temporary disruption in the chief factors of population growth." This is not so surprising a conclusion if Malthus was correct in believing that a high death-rate "makes room" for an increase of marriages and hence births. With this in mind, a *higher* vital index, and not only a return to the former level, might well be expected after war and disease. On the other hand, Dr. Sweeney might, perhaps, have laid a little stress on the fact that though population growth resumes at least its former *rate*, the actual *volume* of births, deaths and population have been reduced, and thus war and pestilence may have somewhat more effect (even if still slight) than his figures and conclusions make apparent.

A. B. H.

4.—*The Evolution of Provincial Finance in British India*. By B. R. Ambedkar, sometime Professor of Political Economy at Sydenham College, with a foreword by Edwin R. A. Seligman, Professor of Economics, Columbia University. London: P. S. King & Son, Ltd., 1925. xxi + 285 pp. Price 15s. net.

This book is described as a study in the provincial decentralization of Imperial finance. If we except a sketch published in 1887 by the late Mr. Justice Ranade, this field of enquiry is unexplored, and the whole work of sifting and classifying the material and presenting it in readable form has fallen upon the present author.

Dr. Ambedkar's treatment is realistic and historical: he declares that to the Chancellor of the Exchequer, finance is eminently practical with a problem to solve, viz. how to bring about equilibrium in the budget, and proceeds to develop his subject from this point of view. The system of 1833 divorced legal responsibility from administrative responsibility, inasmuch as it laid upon the provincial governments the task of preparing the budgets, whilst it laid upon the central government the task of finding ways and means, and consequently some method had to be invented of giving the provincial governments an interest in economical administration and securing freedom

from deficits. The devices adopted are classified in order of their appearance, as budget by assignments, budget by assigned revenues and budget by shared revenues, and each of these headings is treated in considerable detail. The principal conclusion reached is that the Indian system prior to 1919 was not based (as is commonly held) upon separation of sources of revenue with contributions from the yield, but upon aggregation of the sources with distribution of the yield, corollaries being that the provincial governments were merely agents of the central government, and that provincial finance, instead of being an independent system of finance involving freedom to spend, was only a matter of accounting. The reviewer does not consider this conclusion sufficiently supported by the evidence. The justification for expenditure lay in the real needs of the provinces, and whatever the titular rights asserted by the central government, the actual adjustment of burdens was settled by negotiation and compromise, whilst on general grounds it is difficult to see how in a country like India the distant control of the central government could ever have been exercised so continuously and so effectively as to annul the independence and initiative of the provincial governments in the manner suggested.

A substantial portion of the work is devoted to recent reforms. The author is dubious as to the financial soundness of the dyarchical principle, and suggests that it has only been saved from failure by transitory circumstances. It is perhaps rather early to begin drawing conclusions on this matter.

Dr. Ambedkar has not been able to avoid the tendency, common amongst students of blue-books, to treat his subject as if it existed merely upon paper, but on the other hand, his analysis strikes one as accurate and impartial and his comments as sound. His book is a welcome addition to our knowledge of a little-understood subject.

L. R. C.

5.—*The Secret of High Wages.* By Bertram Austin, M.B.E., M.A., and W. Francis Lloyd, M.A., A.M.I.E.E., with Foreword by Walter T. Layton, M.A. 111 pp. T. Fisher Unwin, Ltd., 1926. Price 3s. 6d.

The authors of this book visited the United States in the autumn of last year in order to get a first-hand acquaintance with the manufacturing industry in that country. They published a private report early this year which received considerable circulation, much public comment, and an unrestrained panegyric of praise. The present book has been written in order that the material in the earlier report should be available to a wider circle.

From the authors' point of view there is no doubt that the moment of publication is very opportune. Industrialists are very much out of sorts in this country at the present time, and as the book supplies both employee and employer with cogent reasons for placing the blame for their adversity on to the other, there is no doubt that it will be freely quoted. Employers in this country

are castigated because it is alleged they do not strictly adhere to the policy of promotion by merit and provide facilities by which the wages earned by any one man may be in no way limited; employees, on the other hand, are reminded of "the enormous amount paid out of wages for the maintenance of trade-union organizations," which money is "lost to the workers." The employer, however, receives much greater opprobrium than the employee, since even this loss, due to the weekly payments made by the latter, "would be eliminated under conditions of industry controlled by efficient management," while "inefficient management is directly and solely responsible for 'ca' canny.'"

While there is much in the book to which exception cannot be taken on any ground, there are many hasty generalizations which are entirely unscientific in spirit and quite unjustified. The authors' enquiries appear, for the most part, to have been carried through in the engineering industry, and in particular at Ford's motor factories at Detroit. The extension of the conclusions drawn in such enquiries to the whole of industry in that country and then to this country is definitely anti-scientific. The main thesis set forth is that industrial prosperity arises through each workman being provided with facilities for increasing his output indefinitely and with the assurance that his earnings will advance, *pari passu*, with his output. There is undoubtedly a very close association (not necessarily indicative, however, of causation) between these factors under present circumstances in the industries inquired into. But before generalizations were made the authors should have ascertained if there are industries in the United States where, in spite of these facilities being provided, the industries have not prospered. As a matter of fact, there are such industries—the wool textile and the heavy leather in particular may be cited. In the latter case (an industry which is not without its highly paid workmen) the extension of output with a view to reducing costs led, not to prosperity, but to unparalleled disaster, at a time when the great bulk of the industries of the country were having an exceptionally good time. An examination of the statistics of individual industries published regularly in the "Survey of Current Business" by the United States Department of Commerce suggests that the real cause *may* lie elsewhere, and that high earnings and large individual output may only be factors associated with prosperity and not the *causes* of that prosperity. The figures in the "Survey" indicate that the actual output in the motor and engineering industries in the past year was practically up to the maximum capacity of the plant. In the case of the wool textile and leather industries just referred to, the maximum capacity (specially stimulated for war purposes) was much greater than the 1925 output. In the heavy-leather industry the capacity for production was 50 per cent. in excess of the 1925 output; manufacturers were anxious to employ an increasing proportion of their output, but in face of the limit determined by the consumptive demand for their product could only do so by risking

over-production and consequent selling below cost. A time will no doubt come later on, even in the American motor industry, when the capacity for production will be substantially greater than the consumptive demand, however low the cost of manufacture becomes, and then unlimited output and high wages will no more remain the panacea for prosperity in the motor than it has in the leather industry.

In those industries in this country where it is possible to employ practically the whole of the plant available, *e.g.* in furniture making, prosperous conditions exist, even in the midst of general industrial depression. Who now would seriously suggest that, say, our cotton and shipbuilding industries should give opportunity for unlimited individual output as the means for regaining prosperity in those industries? The authors of this book appear to look upon over-production as an impossibility, but a real study of the vicissitudes of, say, the Lancashire cotton industry in the past few years should convince them that the problem of returning to industrial prosperity cannot be solved by the comparatively simple rules they lay down. Where the conditions as regards capacity for production and consumptive demand are the same in this country as in the United States we find approximate parallelism in results. The real difference is that the States is still at a stage in development (partly due to the fact that an enormous amount of building requires to be replaced in the present epoch) where many industries are able to work at full capacity and few are working at under capacity. Over here there are few working at full capacity but many at under capacity.

Suppose, in order to bring the authors' panacea into action, the officials of the National Union of Boot Operatives (a body which deservedly holds a high reputation for far-sightedness in the interest of its members) decided that there should be no restriction whatever on the manufacture of boots provided the operatives received proper reward for increased output. They would almost certainly fail to persuade the Manufacturers' Federation to agree to the experiment, but if they did there is no reason why, by working longer hours, the production of boots should not rise to the rate of 200,000,000 pairs per annum instead of about 120,000,000 pairs at present, and the cost of production might conceivably be reduced by 1s. per pair. But can anyone imagine that the extra 80,000,000 pairs could be marketed, either in this country or by export? The result would much more likely be a disaster for the employers and a period of unemployment for the employed.

There is little in the way of statistical argument in the book. Figures of average yearly index-numbers of wage rates and wholesale prices in the United States and Great Britain used by Mr. Hoover are quoted with the object of showing that high wages do not imply high prices. While the conclusion may be true, the figures quoted are hardly relevant, without dissection of the data on which the indices, particularly that of prices, are based. Many visitors to the

United States also would probably disagree with the statement regarding the extent of standardization in everyday affairs there (the present writer on a short visit counted 10 different types of water-taps in hotels, clubs, private houses), and would also consider the forecast of the continuation of the present prosperity in that country for some years as a very bold one.

If the book is read in a critical spirit in this country much good should result. It bears evidences of being rather hurriedly prepared, and the full implications of the statements made have not been examined by the authors. If the reader, however, sets in motion an independent train of thought on these statements without necessarily accepting the author's conclusions on them, he will undoubtedly be led through a field of inquiry which should enable him to understand better some of the industrial difficulties of this country at the present time.

E. C. S.

6.—*Family Allowances in Practice.* By Hugh H. R. Vibart, M.A. 237 + x pp., 8vo. London: P. S. King & Son, Ltd., 1926. Price 10s. 6d. net.

As compared with the non-committal report of the International Labour Office and the propagandist exposition of Professor Douglas, Mr. Vibart's study may be described as critical and scientific. He limits his examination to France, Belgium, Holland and Germany, but otherwise uses the same material and covers the same ground.

Having given an historical sketch, Mr. Vibart considers the view of the French employers that the allowance, being entirely independent of the wage, cannot possibly exercise any influence over it. He finds that the question of the inclusion (or not) of family allowances in the basis of assessment of accident compensation does not run parallel with that of deciding whether those allowances do or do not constitute a part of wages. The analysis of the facts is greatly hampered by the paucity of the data supplied to the public by the employers who retain the whole management of the equalization funds in their hands. "It would appear desirable always to express the allowance as a percentage of the wage [of the recipient] when a single establishment or a single industry is in question." In Appendix 2 (a) this is attempted. The percentage of wages of the recipient represented by the allowance for one child ranges from 1.6 in the Bourges Fund (printers) to 7.6 in the Elbœuf-Louviers (textiles) and 8.3 to 10.0 in the Roubaix-Tourcoing (textiles) Funds. For each child of a family of four the corresponding percentages are 3.6, 8.0, 12.5 to 15.0.

"There are three possible sources of the allowances: the profits of the employers, the wage of the single men, and the pockets of the consumer. From which then does the cost actually come?" Mr. Vibart here lapses into the common error of speech which concentrates attention on the single man who may look forward to reaping the benefits of the allowance system during the prime of his manhood and his early married life. He shows quite clearly

and specifically that the allowances have hitherto come out of the wages of all childless workers, and of married and widowed workers whose children have all passed a certain age-limit

The reader should carefully notice every reference to the Roubaix-Tourcoing Fund. "Thus, with living costs only 8.5 per cent. below the figure of sixteen months earlier, the basic wage would have been 17.5 per cent. less. The family allowances, none the less, were still maintained without diminution" [Douglas, p. 90]. "The Roubaix Fund voted that all members of the family over thirteen years should be counted as contributors to the family support, with the exception of wives not gainfully employed and soldiers in active service. Each of these persons who was employed by any member of the Fund was to be paid by his employer his proportionate share of the allowances ascribed to that family" [*id.*, p. 78]. "A large part of the burden of family support would therefore be rolled back upon the shoulders of those industries which employed women and juveniles" [*id.*, p. 232]. "One of the few funds in favour of compulsion is that of Roubaix, where the average contribution is 6½ per cent. of the wage-bill" [Vibart, p. 25]. "Percentage of total workers (employed by members of the Roubaix-Tourcoing Fund) who were single or married without children, 77.94" [*id.*, Appendix 4]. "The average number of children [for whom allowance is paid] per 100 workers is 33 at Roubaix" [*id.*, p. 117].

Space does not permit any criticism of the many different questions raised in such chapters as deal with the mechanism of the Funds, the attitude of labour, the bachelor standpoint, the effect on population, state compulsion, etc. The book is an excellent one; the only fault to be found with it is, that Mr. Vibart never goes outside his material, and in that material the vital questions are hardly touched.

C. E. C.

7.—*A State Trading Adventure.* By Frank H. Collier, C.B. ix + 360 pp. Oxford University Press: Humphrey Milford, 1925. Price 12s. 6d. net.

This is the story of the Ministry of Food from the inside, narrated by one of the comparatively few who were members of its staff throughout its existence. Mr. Collier was among those appointed by Lord Devonport at the outset and succeeded in due course to the Secretaryship, ultimately becoming responsible for the liquidation of the Department. Of all the varied contributions to the economic history of the war this has the distinction of being the most readable. Mr. Collier not only has an animated literary style, but he frequently interpolates comments which are often pertinent, and sometimes impertinent, but always witty. He indulges freely in personalities, and gives at the end of the book a formidable "index of names," but his remarks about individuals are good-natured. Incidentally, he deals justly with Lord Devonport, whose work has been unfairly depreciated. He points out that the policy of the first Food Controller was in strict accordance with the views of the Government at that time, and that it is unfair to blame him for failure to introduce

compulsory rationing in the first six months of 1917, when "the blame, if any, rested on the Government, who always referred to the unspeakable horror of food tickets." Mr. Collier states that Lord Devonport in the course of his administration "prepared four-fifths of the way" for the more drastic measures adopted some months after his resignation. There is shrewdness in the remark that "Lord Devonport was not prone to self-advertisement and presently the newspapers, being given nothing nice to talk about, began to say unpleasant things."

The detailed account given of the working of the Food Control administration is all the more valuable because Mr. Collier makes no attempt to disguise defects or mitigate mistakes. That serious and costly errors of judgment were made is widely known, and Mr. Collier does not conceal them. They do not affect the opinion of all fair-minded men that, viewed as a whole, the record of the Ministry of Food was an amazingly successful effort to grapple with an extraordinarily difficult problem. But history, to be of any value, should chronicle actions which proved unwise as well as those which proved wise. Every successive step, from first to last, was inevitably an experiment, and that a few experiments failed does not detract from the final achievement.

The book is divided into six sections, and the last two, entitled "The twilight of control" and "Outward bound," are of especial interest, as dealing with the post-war period and culminating in the Royal Commission on Food Prices and the establishment of a Food Council. Here Mr. Collier lapses from the detached attitude of mind suitable to war-time and allows political predilections and personal views to obtrude. But while these may affect the historical value of the work, they increase, rather than diminish, its readability.

One general criticism may be made. The scheme of the book is a progressive narrative—from November 15, 1916, when Mr. Runciman announced the intention of the Government to appoint a Food Controller, to the announcement by Mr. Baldwin on June 1, 1925, of the intention of the Government to appoint a Food Council, but in the earlier years the chronology is sometimes confused. It may be hardly worth while to add that the distinction drawn throughout the book between "mandarins" and "adventurers" is somewhat over-worked but never explained.

R. H. R.

8.—*Report upon Large-Scale Co-operative Marketing in the United States of America.* By R. B. Forrester, M.A., M.Com. Economic Series, No. 4. Ministry of Agriculture and Fisheries. viii + 192 pp. H.M. Stationery Office, 1925. Price 1s. 6d. net.

The Co-operative Purchase of Agricultural Requisites. Economic Series, No. 5. Ministry of Agriculture and Fisheries. iii + 110 pp. H.M. Stationery Office, 1925. Price 1s. 6d. net.

These two Reports are complementary to the first Report of this Economic Series, which dealt with co-operative marketing of

agricultural produce in England and Wales. Together they provide the material for forming a sober judgment of the advantages, difficulties and possibilities of agricultural co-operation in this country. They may be read with equal profit by those who regard co-operation as a panacea for all agricultural ills and those who regard it as a fad suited only to amuse theorists.

Mr. Forrester has made a careful study of the recent development of the co-operative marketing of agricultural produce in the United States, and especially of that "large-scale" organization which aims at controlling the sale of the entire output of a particular class of produce. This conception originated in California among the citrus fruit growers as long ago as 1893, and after much tribulation culminated in the California Fruit-growers' Exchange, which has now an annual turnover of nearly £12 million. The report is well arranged and clearly written, and its value is enhanced by a series of tables giving full statistical details of the progress of the movement.

The Report on the co-operative purchase of agricultural requisites is described as "a survey of the present position in England and Wales." Co-operation for purchase, as distinct from co-operation for sale, was started over fifty years ago, and has, generally speaking, been successful, the number of societies which have failed being very few. There are now 193 societies in England and Wales, with a total membership of 60,066 and a total turnover of £8,203,580. They are classified in this Report in three groups, described as Truckload, Storage and Delivery. The first is the simplest form of association, the members combining to bulk their orders and accept delivery by the truckload direct from the source of supply. In the second group purchases are made in bulk, but delivery is taken by the association and the goods are collected by the members in varying, but comparatively small, lots as required. The third group of societies undertake the delivery of the goods to their members, and in most cases also undertake the sale of produce.

The general description of the various kinds of societies and their functions is supplemented by detailed particulars of typical examples of each kind, and a useful analytical summary in tabular form is given in the Appendix.

R. H. R.

9.—*Coal*. By Edward T. Devine. 448 pp. Bloomington, Illinois: American Review Service Press, 1925.

The work, as its full title explains, treats of the economic problems of mining, marketing, and consumption of anthracite and "soft" coal (as bituminous coal is there termed) in the United States of America, a subject on which the author is entitled to write, seeing he was a member of the United States Coal Commission of 1922-23.

The volume is divided into five parts, the subject being considered under the headings—The General Question; The Anthracite

Industry; The Bituminous Coal-mining Industry; Transportation and Marketing of Coal; and A National Policy. Much of the work is of purely local interest; but the main features are of international interest and importance, as pointing to conditions in the industry not dissimilar in some respects from those affecting other large coal-producing countries, and to remedies for meeting these conditions.

America, in the author's opinion, "is more favourably situated with respect to coal than any other part of the world." In regard to quantity, yes; but as to quality and proximity to seaboard, no. In the two latter respects the position in Great Britain is much more favourable than in America.

He does not regard oil as a permanent rival to coal. The supplies of oil in the United States "at the present rate of consumption and waste could not be expected to last more than fifteen or twenty years. We shall soon be importing the greater part of our petroleum products, and although the reserves of the rest of the world are five or six times as great as our own, they would be used up at this rate within two or three generations. With the increasing prices which therefore seem inevitable, it may be expected that the use of oil as a substitute for coal in stationary steam plants will decline."

In Chapter III the country's appetite for coal is considered. This has increased, reckoning in decennial averages, from 0.03 tons *per capita*, 1825-34, to 5.37 tons, 1915-24, but would seem now to have attained its maximum.

Although the output of coal is so far in advance of that of Great Britain, the number of mine-workers is less, being 850,000, about two-thirds of whom are native born; of the foreign element fully one-half are still aliens. Whereas the miners are well organized, the "operators" are not, except in the case of the anthracite mines. The miners' union—"The United Mine Workers of America"—is "international" to the extent that it includes two districts in Canada. Its membership has sometimes reached half a million. That "it is perhaps even more aggressive and successful in protecting the economic interests of its members than the Miners' Federation of Great Britain, whose wage negotiations are made by districts," is not strictly correct.

Private ownership of coal—what we in Great Britain term "ownership of royalties"—exists extensively in the United States, the author remarking that such ownerships are "as legally valid, and to the average citizen seem as little likely to be overthrown, as titles to any other kind of private property."

It is interesting to learn that "the Railway Brotherhood and their members invest funds in coal properties and go into the mining business; and, as one result, get into a controversy, as operators and capitalists, with the United Mine Workers."

The state of the coal-mining industry in the United States is even more confused than in Great Britain. The anthracite mine-owners

(" operators ") are combined, in a manner, to keep up prices. But between individual " operators " in the bituminous coal-mines competition is rife; " there is no typical bituminous coal operator, but only a heterogeneous, unorganized, infinitely diverse and highly competing aggregate, with many representatives of almost any group that could be described from a great corporation to an impecunious, struggling individual."

In the matter of sale and distribution of coal, the machinery does not differ greatly from that in Great Britain. Some 50 per cent. of the coal is marketed by the producing companies, but even they do not, as a rule, sell directly to the ultimate consumer. There are 1,500 wholesale dealers in coal, exclusive of the selling organizations of the producers, 40,000 retailers (*i.e.* one to every 6 or 7 hundred families) and 8 to 10 thousand producers.

In regard to anthracite—the author treats separately of anthracite and soft-coal questions—it is contained in a small area of a single state, *viz.* in Eastern Pennsylvania, and there is a highly concentrated ownership, 90 per cent. of the reserves being owned by the 10 railroad companies. The cost of producing the 90 odd million tons of anthracite per annum is tending to increase, due, largely, to the gradual exhaustion of the thicker seams and the increase in depth from the surface, the output per person employed having fallen from 7.5 tons in 1877 to 4.0 tons in 1922.

The fatal-accident rate is very high, three times that of Great Britain, although the *natural* conditions in the United States anthracite mines are much more favourable to safe mining than in Great Britain. Some of the reasons advanced for this are the backward state of the Mining Regulations and inadequate Government inspection. The chief explanation, however, is that " safety is expensive and that it is a bother to be careful."

The net average annual earnings of all classes of workers at the anthracite mines is (1921) \$1,605—the typical full-year contractor earning on the average \$2,000 a year.

The sanitary conditions of the dwellings are bad, nor does the standard of living correspond with the expectation created by the earnings.

Profits vary greatly, and in the case of 74 operators (who produced all but one-tenth of the output) averaged in 1921 54 cents per ton. The capital value of the anthracite industry is estimated at \$989,900,000.

How vast is the bituminous coal industry of the United States is shown by the fact that the coal areas under operation are contained in about 30 of the States, with an annual output of 500 million tons; in 1920, a year of strong demand, there were 12,122 corporations, partnerships and individuals, operating 14,766 coal mines. About the same amount of soft coal is devoted to domestic consumption as anthracite.

The consumption of soft coal may be divided as follows :—

	Per cent. of the output.
Domestic	10
Exported	4
Bunkers (ocean-going and Great Lakes)	2
Mine consumption...	2
Railroads	28
Public utility	7
Industrial	32
Coking	15
	<hr/> 100

The production of soft coal is on the increase—this over-production being one of the great troubles with which the United States has to contend—and the mines are equipped and manned to produce twice their present output, so that one is not surprised to learn that in 1923 only 179 days were worked on the average. The output per man per day has increased from 2.56 tons in 1891 to 4.48 tons in 1923.

Ninety-seven per cent. of the collieries work on the eight-hour day. The ten-hour day has practically disappeared, and nine hours is the standard in only a small proportion of the mines.

The fatalities in the mines are very high, 4.30 per thousand calculated over the period 1913–22. Were such a state of things to exist in Great Britain a howl of indignation would arise from the public and drastic action be taken by Parliament, but in America the Coal Commission did little more than predict that unless the economic motive for safety and an ordinary decent respect for human life gradually become more effective in making the mines safe for miners, the question will inevitably arise whether more drastic legislative interference *may not be necessary, even if this would mean less coal mined per man and at a higher cost.* The italics are the reviewer's.

The average annual wages in the year 1921, about the worst year the industry ever had, were in union and non-union mines respectively :—

	Union mines	Non-union mines.
	\$	\$
Tonnage men .	1,034	1,051
Outside day men .	1,445	1,220
Inside day men .	1,293	1,125

But it is doubtful whether these figures present a true picture, for the statistics were (year 1921) taken in respect of only 1,177 union mines and 751 non-union mines in 23 States, with an average pay roll of 333,499 mine-workers, and (in 1920) “for supplementary comparison,” 145 union and 140 non-union mines.

As to profit, in 1920, one of the most prosperous years the industry has had, 83 per cent. of the 3,541 companies which filed tax returns with the Federal Government reported a net income averaging 26.57 per cent. of their invested capital ("market capital" in the United States does not include "borrowed capital"). In 1921, a year of serious industrial depression and one of the worst the industry has ever reached, over two-thirds of all the companies reported a deficit.

No estimate is given of the capital invested in the soft-coal industry.

The relations between capital and labour are not pleasant; they do not fight with economic weapons only; "To say that both operators and miners resort to illegal and reprehensible methods is to mention only a symptom . . . the natural end of the warfare which is in progress is not peace but war."

As to the home conditions of the miners, what has been said of the anthracite miner is true also of the bituminous coal-mines. In the "Company towns," where many of the miners have to live, the author epitomizes the situation thus: "The general result is anything but a normal American community of free citizens."

How should the situation in the mining industry be remedied? The author discards nationalization as being outside the present range of practical statesmanship, but as an "emergency means in a crisis it might become 'a live issue'." He eliminates, also, price-fixing by Government; nor, in his opinion, is "trustification" the way out—trustification meaning unrestricted combination or consolidation without the erection of proper safeguards against what has come to be called "profiteering." In "compulsion in industrial relations" he sees no satisfactory way of settling trouble. His suggestions are:—

1. That the royalty owners should mine and market the coal owned by them;
2. The anthracite "operators" should increase their outputs and lower their selling prices;
3. In regard to soft coal—there should be (a) consolidation of properties by "operators"; (b) association of "operators" for determining and carrying out labour policies, sale policies and engineering policies;

which would result in securing substantial economies in administration, elimination of wasteful and injurious competition, closing down high-cost collieries, consolidating car services in times of shortage in places where it can be used most advantageously; the increase of contract sales and in labour-saving devices.

What he has in view is consolidation and integration, under public control, with full public knowledge and with proper safeguarding of public interests.

4. The miners should reduce their numbers, identify themselves with the industry, educate themselves, raise their standard

of living, promote safety in the mines, increase their output, participate in the management.

5. The railroad companies are urged to become carriers pure and simple and to put freight rates upon an equitable basis.

"At present," the author remarks, "we have no national policy except one of drift, punctuated with blind, angry, futile slashing at miners or dealers or operators or railroads in times of scarcity, famine prices, and panic."

In many respects the remedies suggested are similar to those proposed in Great Britain to meet existing circumstances. Though somewhat diffuse and exaggerated in style, the book is eminently readable, and it is illustrated by numerous diagrams.

R. A. S. R.

10.—*Variations in the Composition of Milk.* By J. F. Tocher, D.Sc., F.I.C. 195 pp. Edinburgh: H.M. Stationery Office, 1925. Price £1 1s. net.

The chief basis of this book is the statement made on p. 15 that "it is not clear that the departmental committees which have issued reports in the past recommending minimum limits for the chief constituents of milk have had sufficient scientific evidence to come to a right conclusion." With this in mind Dr. Tocher has carried out an investigation into the variations in the composition of milk at the request of an Inter-Departmental Committee (of which he was a member) appointed by the Secretary for Scotland, in 1920, to report on the Laws, Regulations and Procedure governing the sale of milk in Scotland.

The value of his results lies not only in their usefulness to public administrators, but also in the provision of a very able and thorough study of one of the most important items of dietary, the variation in the constituents of which he finds to be wider than has been hitherto supposed.

The method of research adopted was that of random sampling. Specimens of milk from individual cows were obtained between April, 1921, and June, 1922, the geographical distribution of samples being spread over the counties of Scotland, and fixed so as to correspond with the distribution of cattle (as far as the latter is known).

676 samples suitable for analysis were obtained through the medium of the county official sampling officers and analysed under the direction of Dr. Tocher and Dr. Orr. The statistical study of the data thus provided has been carried out (under the direction of Dr. Tocher) with extreme thoroughness.

Some eleven variables are involved and to the distribution of each of these a Pearsonian curve has been fitted. The various inter-relationships have been studied by the calculation of large numbers of correlation coefficients and correlation ratios with their corresponding regression curves. In these numerous paths of the analysis the mind of the reader is assisted by plentiful illustrations.

Attention is paid to such questions as the seasonal variations in milk-content and yield per cow; geographical differences; differences between morning and evening milkings; prediction formulæ for certain variables; water-content and the various means of testing for adulteration.

With regard to the last, the important conclusion is reached that it is very dubious whether there is any justification for the presumptive limit of 8.5 per cent. of solids-not-fat, below which the sample is presumed to be adulterated, unless the sample is of mixed milk from a large number of cows.

In Dr. Tocher's words, "There is no logical reason why this standard should be retained and there is no logical reason why this figure should be selected as an absolute legal minimum limit." A further point of practical importance is that farmers with small herds run a greater risk of prosecution than do those with large herds.

A very full and ample summary of results is provided, as well as a short statement of general conclusions. In an appendix occupying nearly sixty pages the analytical data are given as well as all the correlation tables and regression tables (observed and theoretical array means of second character for sub-ranges of first character). Though ideal in theory, this procedure, it is suggested, has its drawbacks in practice especially in these days of costly printing. In a subject which is of importance in public administration, a wider circulation at a lower price seems, perhaps, more desirable than the provision of such detail of value to the relatively few.

A. B. H.

11.—*Report on the Trade in Refrigerated Beef, Mutton and Lamb.* Economic Series, No. 6. Ministry of Agriculture and Fisheries. vi + 65 pp. London: H.M. Stationery Office, 1925. Price 1s. 6d. net.

This Report brings together the main facts and figures relating to our oversea supplies of meat. The field has been largely covered by the Royal Commission on Food Prices and the Linlithgow Committee, but a convenient summary of the subject is welcome. The description of the conditions under which meat is shipped to this country from the main sources of supply, and of the commercial organization by which it is landed and distributed, is clear and concise. The statistics and diagrams, so far as they go, are useful, but they are somewhat less detailed than might be expected in a Report of this kind.

R. H. R.

12.—*Germany's Industrial Revival.* By Sir Philip Dawson, M.P. x + 276 pp. London: Williams and Norgate, Ltd., 1926. Price 10s. 6d.

The title of this book is a sufficient description of its contents. An engineer, not an economist, has written it; hence those parts of it which treat of practical engineering questions are the most interesting and convincing. It contains a large assortment of facts,

figures and statistics, mainly official, from which, by means of a useful index, the thoughtful reader can draw his own conclusions. It is hard to feel as much confidence in the conclusions drawn by the writer himself. He states clearly and confirms fully some of the well-known facts about Germany, such as her rapid industrial development before 1914, her inability to pay large indemnities in the first years after the war, her present determination to use her natural resources and the industry and skill of her people to regain her place as a leading industrial country. But there are other statements more meagrely supported which obviously require further discussion: for instance, his conviction that the destruction of German credit, through the inflation of the currency, was a deliberate plan (p. 29); his unmeasured condemnation of the use of coloured troops by the French army of occupation (p. 166); his brief assertion that our high costs of production are largely due to high wages and short hours (p. 255). An explanation in the Preface that this book is in fact what its style and arrangement clearly proclaim it to be, namely, a collection of magazine articles, disarms further criticism on these counts.

D. M. B.

13.—*La Salute Pubblica in Italia durante e dopo la guerra.* Giorgio Mortara (Professore ordinario di Statistica nella R. Università di Milano). Pubblicazioni della Fondazione Carnegie per la Pace Internazionale. Sezione di Storia ed Economia. Serie Italiana. Bari: Guis. Laterza e Figli, Editori; New Haven: Yale University Press, 1925. 577 + xxiii + [16] pp. Price 70 lire.

The aim of the series to which this book belongs is to give an economic history of the war and its social consequences. The series consists of individual monographs written by scientific men who are not only experts in their subject, but have been in touch with the course of events in their own country during the war. Separate national editorial committees appointed by the Carnegie Foundation direct the work in each country.

Professor Mortara's volume deals with the effect of the war on the public health in Italy. The many gaps in the available material and the duty of preserving any details that may be of value to the whole picture account for any want of balance that the reader may find in the relative space allotted to the various themes treated.

The author first discusses the course of the population as a whole, and finds that it shows little net effect of the war, as the large loss of life between 1915 and 1918 and the defect of births between 1916 and 1919 were partially compensated for by the return to their country of Italians living abroad and the drying up of the usual large stream of emigrants from Italy.

Book I deals with mortality and sickness. The sources of the various figures are critically examined, deficiencies noted and different estimates compared. Deaths are treated separately under the following classifications: in the fighting forces, among prisoners, those due to enemy attacks on the civil population, in the regions

occupied by the enemy, and in the civil population in general. These last are also considered by months, sex, age, district and cause.

The total mortality in Italy shows the characteristic common to most of the belligerent countries except Roumania; after the high peak caused by the war and the influenza epidemic it returned to the same evenly descending course it followed from 1890 to 1913. Analysis by age, district, and cause shows, however, that notable increases traceable to the war still persist, masked partly by changed age composition, and partly by compensating decreases.

The author estimates the number of deaths in the army (including military marine) at 600,000, *i.e.* an excess of about 500,000, and generalizing from detailed official figures available for Bologna, calculates that these men left 200,000 widows and 400,000 orphans. The blackest time in the war for Italy began in the last months of 1917 after the defeat of Caporetto. This was followed by the double tragedy of the privations of the population in the invaded districts and the increased suffering of the prisoners. The population remaining in the occupied area is estimated roughly at 970,000, and among these the death-rate (though varying greatly according to geographical position) was approximately $2\frac{1}{2}$ times the normal rate. The number of prisoners is given as about 580,000, of whom 90,000 to 100,000 died, and of these 80,000 to 90,000 of illness, in spite of the fact that epidemics were not rife among them. Professor Mortara calculates that the mean annual death-rate among Italian prisoners was 12 per cent., as against one of 3 per cent. among enemy prisoners in Italy. Tuberculosis, respiratory diseases, hunger and malnutrition rank first in the causes of death among Italian prisoners. As a result of differential treatment the mortality of the lower ranks was $2\frac{1}{2}$ to $3\frac{1}{2}$ times that of the officers. The influenza epidemic of 1918-19 is treated in detail; the excess of deaths directly or indirectly attributable to it is estimated at 600,000, the heaviest incidence being in the south.

The analysis of mortality by age and district suffers in some cases from want of exact data for the exposed to risk. Index-numbers have therefore been used, taking as standard the corresponding mean annual number of deaths in the same class in the three years 1911-13. The most gravely affected age-group during the war was naturally that of males aged 15-45; next to this come the same years among females and the 5-15 year age-group in both sexes. Infantile mortality suffered relatively lightly from war conditions, and the post-war course of the 5-10 year age-group does not justify the gloomy predictions made as to the lowered vitality of "war-babies." As regards epidemics, the outstanding facts of the war mortality in Italy are the influenza of 1918-19, the cholera of 1915-16, the large progressive increase in malaria, and the increase in mortality from typhoid and diphtheria.

Apart from the influenza and cholera epidemics, the average incidence of illness in the army in the field was 3 to 4 per cent. continually sick. For the civil population few data as to illness are

available. The influx of returned emigrants in the early days of the war does not seem to have had any directly traceable effect on the public health. The first signs of disadvantage were shown after the massing of men near the frontiers, and illness increased with the rapid movement of men from place to place and the gradual deterioration in the conditions of life.

The course of the ratio of male to female deaths from typhoid from 1912-23 is interesting, indicating the effect of inoculation of large numbers of adult males and the gradual subsequent wearing out of their relative immunity. The appearance of a decrease of the same ratio in other infective diseases, against which there was no inoculation, suggests that selection during the campaign, and possibly immunization against infection acquired during the life in the trenches, also played a large part.

The total improvement in mortality from tuberculosis (all forms) in the post-war period covers an increase in pulmonary tuberculosis and a decrease in other forms. One of the minor consequences of the war which is entirely beneficial is the decrease both during and after the war of the incidence of pellagra, attributed to the change from a diet consisting mainly of maize "polenta" to a more mixed diet.

Book II deals with births and marriages. The Italian birth-rate began its descent about 1885, and after the severe drop during the war and the recovery in 1920 it has continued the same downward course. The estimated actual deficit in births due to the war is nearly $1\frac{1}{2}$ millions. Regional analysis shows considerable geographical localization in the changes in the birth-rate. The greater decreases in Liguria, Piedmont and Lombardy, where the birth-rate is lower than that of France, while in Basilicata and Puglie it approaches the high figures of Roumania, support the opinion that the main factor is the spread of the custom of voluntary birth restriction. In the case of Sicily, however, where the decrease is also apparently large, more difficulties arise in the explanation. The still-birth rate did not show any appreciable rise till the influenza epidemic, but remained high in 1920-1.

The few stray gleanings given above do not do justice to Professor Mortara's careful analysis of the available facts, as the detailed nature of the book does not lend itself to summary description.

All the relevant data are clearly set out in Appendices with indications of the sources, and a bibliography of $6\frac{1}{2}$ pages is given. Apart from the convenience of the collection of this material in one volume, the value of the work (especially for the foreign reader) lies largely in the critical evaluation of the figures and their analysis by an author who is in a position to appreciate their meaning fully. The student of social conditions in Italy will find this book a valuable aid. Professor Mortara's clear style is not difficult to follow, even by the reader with no very large command of the Italian language.

E. M. N.

14.—*The Economic Development of Russia, 1905–1914, with special reference to Trade, Industry and Finance.* By Margaret S. Miller, M.A., B.Com., Ph.D. xviii + 307 pp. London: P. S. King & Son, Ltd., 1926. Price 12s. 6d.

The period dealt with in the book under review comprises, within the narrow compass of some ten years, enough events and developments to fill a century. Both politically and economically, the few years that elapsed between the abortive revolution of 1905 and the Great War of 1914 were a period of *Sturm und Drang*. Looking back at that time, one cannot fail to perceive that something like the awakening of Russia to more active life was taking place. A good deal was actually achieved, but the process subjected the whole social and political structure of the empire to a tremendous strain, involved in the reorganization of practically all branches of national life. Politically, the country was making a transition from autocratic to representative government, with all the unavoidable friction attendant on this process. Economically, it was building up her industrial power and turning to account her vast natural resources, on the one hand, and, on the other, rapidly reorganizing her peasant farming on new and progressive lines. Socially, the development of industry and trade, along with the gradual breaking-up of the rural commune, were bringing into prominence two new classes hitherto hardly known to Russia at all: the *bourgeoisie* and the industrial proletariat. Many cross-currents of facts and opinions tended to blur the picture which presented itself to the eyes of the contemporary: neither is it an easy task for the historian of our day to pass a judgment on the rôle played in Russian history by that eventful decade. Miss Miller has thus chosen a subject in dealing with which she had to proceed very cautiously; she can indeed be congratulated on having succeeded in steering clear of the many rocks that lay in wait for her ship, and on having produced an excellent account of the economic evolution of Russia in the years immediately preceding the Great War. The bibliography appended points to wide and varied reading, and testifies to the seriousness with which the author approached her task. The treatment of the problems dealt with differs, indeed, very favourably from that commonly met with in those "impressionist books and pamphlets" about Russia, on which Baron Meyendorff makes some fitting comments in his introductory note to the volume. The generalizations are few and guarded, and, on the whole, well substantiated by the known facts. Among them, one seems to be especially to the point, as helping to explain a good deal in the recent history of Russia. Miss Miller emphasizes the paramount and, indeed, dominating rôle of the State in the direction of economic activities under the old *régime*, and its adverse influence on the development of private initiative and individualism in industry and trade—a shrewd observation, which goes to the root of many a problem.

A commendable feature of the book is the inclusion, at the end of each section, of separate tables of relevant statistical data with

detailed indication of their sources. The figures, though of necessity taken mainly from other than original sources, would appear to have been carefully analysed and checked, with the result that their second-hand origin, unavoidable in the circumstances, does in no way vitiate the validity of the statement.

It is, however, a matter of regret that lack of time prevented the author from including an account of the great agrarian revolution following on the land settlement legislation of 1906. The importance of these changes in determining the structure of the social and economic system of Russia, as it gradually emerged from the process of reorganization, is so fundamental that their practically complete omission tends somewhat to distort the picture otherwise so ably and carefully drawn.

At one point, at the very beginning of the book, the author would appear to have forgotten her characteristic caution and followed an erring authority, indicated in a footnote, into an awkward corner. To say that "the concentration of effort rendered possible by the institution of serfdom" was one of the forces which helped the Russian State to throw off the Tartar yoke, is to commit a grave chronological error, because serfdom did not make its appearance in Russia until a century after the last vestiges of dependence were done away with, and was first finally consolidated by the provisions of the Code of 1649. This, however, is only a slip irrelevant to the problems actually discussed.

G. A. P.

15.—*Factory Legislation and its Administration, 1891-1924.* By H. A. Mess, B.A. 228 + xii pp., 8vo. London: P. S. King & Son, Ltd., 1926. Price 12s. 6d. net.

This is a most admirable account, both historical and descriptive, of all that concerns the Factory Department of the Home Office, as it requires to be told to those who are turning their retrospections to the future. Nothing in the past is dug up which has no relevance to present conditions; nothing which is relevant appears to have been ignored. The first chapter, on factory legislation prior to 1891, and the second, a general survey of factory legislation, 1891-1924, might with advantage be adopted as a text-book for the use of sixth-form students in schools. The subsequent seven chapters on the regulation of dangerous trades and on the general advance during the period are remarkably clear, at the same time that nothing important in the mass of detail involved seems to have been omitted.

The review of the war period and its effect upon factory legislation should be read by every one who has failed to unravel the tangle of those days. The same persons probably will appreciate the enlightenment afforded by the chapter on international action.

Throughout, the Factory Bill introduced by the Home Office in 1924 receives special attention. The final chapters on the enforcement of the law, opinion and propaganda, and "other industrial

legislation of the period" are, of course, more controversial, but are free from bias, other than a slight tendency to regard legislation as good in itself.

The brief statistical sections are the weakest in the book.

C. E. C.

16.—*Local Government in Many Lands*. By G. Montagu Harris, O.B.E., M.A. viii + 341 pp. London: P. S. King and Son, Ltd., 1926. Price 15s.

This work had its origin in a request from the Royal Commission on Local Government for information as to the systems of local government in being in a number of foreign states and in the British Dominions. Reports were obtained by the Foreign, Colonial and India Offices; Mr. Montagu Harris, as an officer of the Ministry of Health, had the task of preparing for the Commission memoranda based upon those reports, and has now utilized them to produce the present volume, in which he has included sketches of the systems of the United Kingdom and the Irish Free State, and a general summary of the salient features of the various systems thus surveyed.

The result is a careful and laborious compilation, dealing with twenty-one countries of Continental Europe, the British Isles, Canada, Australia, New Zealand, South Africa, British India, the United States and Japan. As this is done in 302 pp. (excluding the introduction and the final summary and review), it will be apparent that very little more than an outline sketch can be given in any one case. In fact, Mr. Montagu Harris is concerned almost solely with the legal structure of the organizations described, and tells us very little of the manner in which they actually function, though he recognizes (p. 8) that in political institutions often "the substance is more important than the form." He goes on to remark that "although it would seldom, if ever, be wise for one nation to accept wholesale the governmental institutions of another, whose racial and national history run on altogether different lines, there are few countries which are not searching for some means of improving one or another portion of their governmental machinery, and it might well be that such means might be found, in some instances, by the adaptation of a method already in force elsewhere." This is at best a very qualified appreciation of the utility of the comparative study which he has undertaken; but even if we accept the proposition as it stands, it is evident that no conclusion as to the adaptability of an institution can safely be drawn until we know the precise conditions in which it has functioned and its actual effects. The most the present book does is to suggest possible subjects for investigation. As a simple illustration of the extent to which a description of the legal position may be misleading, it may be remarked that on p. 11 Mr. Harris states that the Council-General of a French department "may pass resolutions on any subjects other than political." This is formally true, but, as

Mr. Sisley Huddleston remarks (*France and the French*, 1926, p. 191), "the prefect . . . should forbid a vote on political questions. In point of fact he allows the Conseil-Général to pass congratulatory motions to the Government of the day."

Whilst the subject-matter of the book is thus, we think, unfortunately, though perhaps inevitably, too restricted on the one hand, it suffers on the other from the breadth of its survey. Twelve pages are devoted to necessarily very sketchy accounts of local government in British India, though the writer admits (p. 267) that to compare the administrative organization of industrial western nations with that of British India "would be a futile task." The pleas that it seemed undesirable to omit any mention of the Indian Empire, and that the Indian system is of intense interest, would equally warrant the inclusion of other parts of the Empire not dealt with in the volume, and also of Russia and China, which are likewise omitted. The very brief accounts of Esthonia (pp. 156-7), Poland (pp. 163-5) and Roumania (pp. 165-6) are of small value.

It is perhaps unavoidable that in a book so wide in scope and based on data so collected there should be a number of details which need elucidation and occasional obscure phrases. Thus it is stated (p. 7) that in France it is a disqualification for election to a municipal council to be "under the supervision of a judicial council," and (*id.*) that "the municipal council must meet at least four times a year . . . The budget session may last for six weeks, the others for fifteen days"; that (p. 18) in the French departments the heads of the organization for elementary education are "the prefect and the academy inspector," though the "academy" is nowhere else mentioned and the real position of the inspector is not explained; that (p. 76) the electoral franchise is possessed in the Danish communes by every man and woman who is, among other things, "of good reputation"; and that (p. 81) in Denmark a school-board is established in connection with every "deanery"—an area nowhere defined.

Despite these general criticisms. Mr. Montagu Harris has produced a useful guide to those who, whether as academic students or practical administrators, are interested in the organization and working of local government and the relations between the central and local authorities. Its perusal will suggest a number of interesting subjects of investigation, *e.g.* the causes of the influence of the French system upon the systems of the other countries of Western Europe; the development of the commission and "city manager" systems of municipal government in the United States, and tendencies towards adopting the latter method elsewhere; and the extent, forms and working of central control over the actions of local authorities.

P. A.

17.—Other New Publications.*

Annali di Economia. Vol. primo, No. 2, Giugno, 1925. Milano : Università Bocconi Editrice, 1925.

[The first issue of this new periodical was briefly noticed in the *Journal* for March last year. The present issue consists solely of a report by Prof. M. Pantaleoni on the crises of 1905-7. It was drawn up in connection with an appeal against damages for non-fulfilment of a contract due to a crisis in the iron and steel trade. The matter was referred to experts, one of whom was Prof. Pantaleoni, and the above important study on the relation of economic conditions to the due execution of contracts is the result.]

Clarke (John J.), M.A. Housing in relation to public health and social welfare. Being the third Kibble Memorial Lecture delivered at Birmingham, 1925. 40 pp., crown 4to. Liverpool University Press and Hodder & Stoughton, 1926. Price 9d.

[Mr. Clarke, in his interesting survey, deals with the evils of the two kinds of overcrowding, namely, too many houses built on any given area and too many people living in one room or house, and their effects on the general physical condition of the people. The results of re-housing and the reduction of disease arising therefrom, and the general economic aspects of the problem, are also considered. There are numerous statistical tables and charts.]

Compendium of R.A.O.A. Arbitration and Appeal Cases. Vol. I, 717 pp., 8vo. Washington : Railway Accounting Officers Association, 1925.

[This volume consists of the reports of close on 200 cases submitted for arbitration by American railway companies, the matters in dispute being of a very varied description. In each case, the nature of the claim and the findings of the arbitration committees are given. The book, which has been compiled by Mr. E. R. Woodson, is primarily for the use of railway officials and is well indexed.]

Darling (J. F.), C.B.E. Economic unity of the Empire. Gold and Credit. 41 pp., 8vo. London : P. S. King & Son, 1926. Price 1s. net.

[The author urges the necessity for economic unity within the Empire, for its development by increased production of raw materials in the Dominions and their use and manufacture in industrial Britain. The recent return to the gold standard, which has been regarded as an incentive towards this unity, has its drawbacks which are described by the author, and he suggests a rearrangement of gold credit as a remedy, the details of which are set forth in his address.]

Fateh (Moustafa Khan), M.A. The Economic position of Persia. vii + 98 pp. London : P. S. King & Son, 1926. Price 6s. net.

[Mr. Fateh's study was first written in 1919 as a thesis for his degree at Columbia University and is now published in a much revised form. It is an endeavour to describe present-day economic conditions in Persia and to suggest such remedies as may be possible and practical. The book opens with a short description of the physical conditions of the country,

* See also "Additions to the Library," p. 628 *et seq.*

and succeeding chapters deal with agriculture, which is its main industry and is dependent largely on irrigation, its mineral resources, and the oil industry with its enormous possibilities. The various other industries so far as they exist are also briefly described, their development being retarded mainly by lack of modern transport facilities. The remainder of the book is devoted to finance and banking and trade and commerce of the country. In reviewing the prospects for the economic development of Persia, the author is strongly of opinion that foreign capital is essential for such development.]

Jack (D. T.), M.A. The Economics of the gold standard. vi + 88 pp., 8vo. London: P. S. King & Son, 1925. Price 3s. net.

[The object of this little book is to explain the meaning of the recently reintroduced gold standard into this country and the machinery by which it is maintained. It is in four chapters, the first relating to the meaning of the gold standard and its relation to the standard of value, the second on gold in the international market, and the influence of its general adoption on a certain uniformity in the value of money in those countries with a gold standard. Chapter 3 describes the return to gold, and the final chapter is an attempt to consider the probable future position of gold in relation to its efficiency as a standard of value, based on the past experience of this country after the Napoleonic wars.]

Jones (J. Morgan). The Poultry industry of Wales. A survey of stocks, methods and prices. 49 pp. Aberystwyth: Agricultural Economics Department, University College of Wales, 1925. Price 1s.

[A study of the methods and periods of poultry production in Wales, with suggestions for its more general development in that country. Changes in poultry stocks and their distribution during recent years, egg yields, supplies and prices of eggs, and methods of marketing are briefly described. There are several statistical tables and graphs.]

Mortara (Giorgio). Prospettive economiche. Anno sesto, 1926. xxiii + 480 pp., 8vo. Città di Castello, 1926. Price 40 lire.

[Prof. Mortara's valuable compilation, now in its sixth year of issue, has been briefly noticed in the *Journal* for some years past, and as the present volume follows much the same lines as its predecessors, there is not much ground for fresh comment, beyond saying that it takes its place among those valuable works of reference for students and others requiring up-to-date and reliable information concerning the production, distribution and consumption of the main commodities of Italy and other countries, with commercial forecasts for the present year.]

Pribram (Prof. Dr. Karl). Probleme der internationalen Arbeitsstatistik. 16 pp., 8vo. Jena: Gustav Fischer, 1925.

[Dr. Pribram's pamphlet reviews briefly the difficulties of obtaining uniformity in international statistics of wages and the cost of living, the classification of industries and occupations, hours of labour, industrial accidents and social insurance. The author, who is the Chief of the Statistical Section of the International Labour Office, also describes its efforts to secure these results.]

Repaci (Francesco Antonio). I risultati finanziaria della gestione delle ferrovie dello Stato (1905-6—1923-4). 103 pp., 8vo. Torino: Fratelli Pozzo, 1925.

[An economic and statistical study of the financial results of the working of the State railways in Italy during the last eighteen years, and of the

efforts that have been made to reduce the losses incurred in recent years. The study is in four parts, the first dealing with the pre-war period, the second with the effects of the war on the railways, the third with the post-war period, and the last consisting of a detailed examination of their working during the financial year 1923-4. The articles originally appeared in various issues of *La Riforma Sociale*.]

Roberts (Frederick), M.C., F.C.I.S. Everyday economics. A few notes for students, social workers, and general readers. vii + 132 pp., 8vo. London : Gee & Co., 1925. Price 7s. 6d. net.

[Mr. Roberts' little treatise is intended as an introduction to more advanced study, but is itself a useful compendium of the main principles of economics. It is in two parts: the first consists of 14 short chapters which deal with the principal heads of economics and also the causes and remedies for unemployment and the arguments for and against a capital levy. The second part is made up of Appendices which include an explanatory list of economic and commercial terms, a short list of books suitable for further study which, in regard to statistics, might have been fuller, and the gold standard Act of 1925. There is also a list of recent examination questions set by various examining bodies and an index.]

Ulster Year-book, 1926. Published by authority of the Minister of Finance. xiv + 142 pp., 8vo. Belfast : H.M. Stationery Office, 1926. Price 2s. 6d. net.

[The first issue of the *Ulster Year-book* is a useful book of reference, and gives a compact statistical account of the various economic and social activities of the country during recent years. It contains the statistics which became available during 1925 of the services transferred to the Government of Northern Ireland, and also those of the reserved services which continue to be published in the reports of the Imperial departments, in so far as they concern Ulster. The book contains maps and diagrams and a full table of contents, and there is a selected list of official publications of the Government of Northern Ireland and of the Imperial Government relating to the country.]

CURRENT NOTES.

WHILE the figures of March trade were more cheerful in appearance than those of the two preceding months, there was, compared with last year, a set-back in April, which cannot be attributed to the incidence of Easter holidays, since these occurred in April both last year and this year. Taking March and April together, however, the percentage falling-off in values compared with last year was less than in January and February taken together for imports, exports, and re-exports alike, though the decrease was less for each of the two last than for the first.

Our usual comparison of the twelve monthly periods in the present case, those ended April this year and last, shows larger reductions in values in the more recent period than were shown by the figures given in our last issue, but whereas the reduction in total exports shown in those figures was greater than that in total imports by some £17 millions, the table below shows that the reduction in total imports was greater by £8 millions than that in total exports. The excess of merchandise imports, which was £396 millions in the twelve months ended April, 1925, was £388 millions in the twelve months ended April, 1926.

The more detailed comparison of the two periods was as follows :—

	Twelve Months ended April 30, 1926.	Twelve Months ended April 30, 1925.	Increase (+) or Decrease (—) in later period.
Imports, c.i.f.—	£'000.	£'000.	£'000.
Food, drink and tobacco	560,342	592,540	— 32,198
Raw materials and articles mainly un- manufactured	403,558	432,255	— 28,697
Articles wholly or mainly manufac- tured	315,240	320,331	— 5,091
Other articles	5,307	6,884	— 1,577
Total imports	1,284,447	1,352,010	— 67,563

	Twelve Months ended April 30, 1926	Twelve Months ended April 30, 1925.	Increase (+) or Decrease (—) in later period.			
Exports, f.o.b.—	£'000	£'000.	£'000.			
<i>United Kingdom Pro- duce and Manufactures—</i>						
Food, drink and tobacco	53,331	57,871	— 4,540			
Raw materials and articles mainly un- manufactured	78,957	99,773	— 20,816			
Articles wholly or mainly manufac- tured	596,505	636,360	— 39,855			
Other articles	17,075	20,345	— 3,270			
<i>Imported Merchandise—</i>						
Food, drink and tobacco	30,560	30,304	+ 256			
Raw materials and articles mainly un- manufactured	90,944	76,594	+ 14,350			
Articles wholly or mainly manufac- tured ...	28,757	34,247	— 5,490			
Other articles... ..	113	161	— 48			
Total exports	896,242	955,655	— 59,413			
Bullion and Specie—						
Imports	52,674	46,189	+ 6,485			
Exports	54,786	53,086	+ 1,700			
Movements of shipping in the Foreign Trade:	Number of Vessels	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.
<i>Entered with cargoes—</i>						
British	32,161	38,212	31,625	37,950	+ 536	+ 262
Foreign	23,196	17,780	22,864	18,715	+ 332	— 935
Total	55,357	55,992	54,489	56,665	+ 868	— 673
<i>Cleared with cargoes—</i>						
British	38,475	41,658	40,647	42,138	— 2,172	— 480
Foreign	21,981	20,904	24,722	22,968	— 2,741	— 2,064
Total	60,456	62,562	65,369	65,106	— 4,913	— 2,544

The quarterly calculations relating to the price changes which affect the value aggregates of imports and exports, published in the *Board of Trade Journal*, show that, for the twelve months ended March, both imports and re-exports were of practically the same volume in the period 1925-26 as in the period 1924-25, but that the volume of exports of goods of United Kingdom production was

smaller by over 3 per cent. in the more recent of these periods. For imports, the later period shows average declared values per unit of quantity about 2·7 per cent. lower than a year earlier, re-exports show average values nearly 0·6 per cent. higher, and exports show average values about 4·5 per cent. lower in the later period. Unless, in the periods shown in the table given above, improbable changes in the average price levels occurred, as compared with years ended a month earlier, not far short of three-fifths of the recorded fall in aggregate value of imports and of domestic exports was due to price changes, only the remainder indicating decreased quantities.

The main part of the comparisons of volume and of average values in our external trade quarter by quarter has, in the more recent studies published by the Board of Trade, been based on the movements since 1924, the comparisons with 1913 being given a somewhat subordinate place. Since the setting up of the Irish Free State as a separate entity for trade statistical purposes, the presentation of direct comparisons of current trade with the trade of 1913 has involved a hypothetical reconstruction of the trading units of 1913, and the data for doing this satisfactorily are not available. The estimates published are, nevertheless, of considerable interest, and we deduce the following for the volume of trade of the British Isles in the first quarters of 1924, 1925, and 1926, the figures for the first quarter of 1913 being taken as 100 in each case:—

January-March.	1913.	1924.	1925.	1926.
Total imports	100	99 8	113·7	112·1
Re-exports	100	105·7	93·0	89·0
Exports (domestic) . . .	100	75·2	81·3	80·4

The level of wholesale prices, as measured by the Board of Trade index-number, continued to fall during March and April. For the month of March prices were on the average 2·3 per cent. lower than those for February. All of the food groups showed substantial decreases, the average level being lower by 3·2 per cent. Although there was no exception to the downward movement among the industrial materials groups, the reductions, except in the case of cotton and other textiles, were small, the average reduction for the whole class being 1·8 per cent. Average prices for April compared with those for March revealed a further slight reduction of 0·5 per

cent. Food prices were actually higher by 1.3 per cent., a substantial increase in cereal prices, with a less increase in other foods, more than balancing lower prices for meat and fish. The prices of metals and minerals other than iron and steel remained unchanged, but in every other group of industrial materials there were further reductions, effecting for all industrial materials an average reduction of 1.3 per cent. The effect of these changes upon the total index-number, having as its base average prices for the year 1924, was to reduce it from 86.8 from March prices to 86.4 for April prices. If 1913 average prices be taken as the base, the corresponding figures were 144.4 and 143.6 for March and April respectively.

Similar decreases in wholesale prices, as measured by the *Economist* index-number, were shown at the end of March and at the end of April, this being the eighth successive monthly reduction according to this record, and bringing the total index-number to 184.2, the lowest point recorded since March, 1916. These changes reduced the increase over the pre-war level, i.e. prices at the end of July, 1914, to 58 per cent.; the greatest increase of those making up this average figure was in food other than cereals and meat, prices of which were still 93 per cent. over the pre-war level, and the least was in the miscellaneous group, where the corresponding increase was only 39 per cent.

According to the *Statist* index-number, wholesale prices at the end of March were 1.4 per cent. lower than a month before, and by the end of April there had been a further reduction of 0.5 per cent., bringing the total index-number at the later date to 125.5. The increase over the average for 1913 at the end of April is put by the *Statist* at 48.4 per cent.; with this may be compared the corresponding increase of wholesale prices in the United States as measured by Bradstreet's index-number, viz. 42.3 per cent.

The average rise of retail food prices in Great Britain and Northern Ireland since July, 1914, which was put by the Ministry of Labour at 65 per cent. on March 1, fell to 59 per cent. on April 1, and further to 58 per cent. on May 1, as compared with 67 per cent. on May 1, 1925. In March the fall was chiefly due to reductions in the prices of eggs and milk, but there were also slight reductions in the average prices of most of the other articles of food included in the statistics. By the end of April, prices of flour, bread, and bacon showed a slight advance, but against these were to be set seasonal reductions in milk,

butter, and cheese, while potatoes and fish were also somewhat cheaper.

If rent, fuel, clothing, etc., be included with food, the average increase of retail prices on the pre-war standard of comfort, which stood at 72 per cent. on March 1, fell to 68 per cent. on April 1, and further to 67 per cent. on May 1, as compared with 73 per cent. a year before. From the fact that the food items accounted for 60 per cent. of the total family budget in July, 1914, it appears that, on May 1, the average increase in the items other than food was just over 80 per cent.

The following table summarizes for the chief countries the latest information as to retail prices overseas as reproduced in the *Labour Gazette*. The third column gives the percentage increase in retail food prices on those ruling in July, 1914, or some similar pre-war period; the fourth column gives the estimated increase for all the items covered by the budget in each case, such items, in addition to food, comprising generally rent, clothing, fuel and light, and other household requirements.

Country.	Date of latest return.	Food.	All Items.
<i>Foreign Countries.</i>			
		Percentage increase.	Percentage increase.
Belgium	April, 1926	—	429
Denmark	January, 1926	77	94
Egypt (Cairo)	February, 1926 ...	59	—
France (Paris)	March, 1926 ...	397	351 (1st qr. 1926)
France (other towns)	February, 1926	403	—
Germany	April, 1926	43 (Jan.)	40
Holland (Amsterdam)	December, 1925....	45	77
Italy (Milan)	March, 1926	554	554
Norway	April, 1926 ...	98	125 (Mar.)
Spain (Madrid)	March, 1926	85	—
Sweden	April, 1926	58	73
Switzerland	February, 1926	63	65
United States	February, 1926	58	78 (Dec., 1925)
<i>Overseas Dominions, etc.</i>			
Australia	February, 1926	54	56 (4th qr. 1925)
Canada	April, 1926	53	53
India (Bombay)*	April, 1926	50	53
Irish Free State	January, 1926	87	58
New Zealand	April, 1926	51	62
South Africa	March, 1926	18	31

* Native families.

In continuation of statistics relating to employment in Great Britain and Northern Ireland, quoted on p. 363 of the March *Journal*, returns from trade unions with a total membership of approximately one million members showed 10·1 per cent. of the members as unemployed at the end of March, as compared with 10·4 per cent. a month before, and 9·0 per cent. a year before. Owing to the strike the Ministry of Labour was unable to obtain at the usual time these returns for the end of April. With this figure may be compared the percentage unemployed among the workpeople, numbering 11,892,000, insured under the Unemployment Insurance Acts in Great Britain and Northern Ireland. Standing at 10·5 on February 22, it fell to 9·8 on March 22, and still further to 9·2 on April 26, as compared with 10·9 on April 27, 1925. Some indication of the magnitude of the aggregate figures corresponding to these percentages is given in the returns published by the Ministry of Labour showing the total number of persons registered at Employment Exchanges in Great Britain and Northern Ireland as applicants for employment at various dates. On March 29 this figure was approximately 1,070,000, and on April 26 it had been reduced to 1,034,000. A comparison with the position of a year before, as reflected in employers' returns received by the Ministry of Labour, is given in the following table. The returns relating to coal mining and to the iron and steel trades cover the whole month in each :—

Week ending	Coal-mining. Increase or decrease on a year ago in days worked per mine per week.	Iron and steel trades. Percentage change on a year ago in aggregate number of men-shifts.	Other trades covered by the returns. Percentage change on a year ago.	
			Numbers employed.	Wages paid.
March 27	+ 0·10	+ 4·0	— 0·3	+ 1·5
April 24	+ 0·29	+ 4·6	— 0·3	+ 3·2

Official statements as to employment in Germany, as summarized in the *Labour Gazette*, showed that the continuous decrease in employment which had been proceeding during the previous months was checked in February, and during March there was an improvement, which, however, did not extend to the "key industries" such as mining, metal, textile, or building. The number of unemployed on the "live register" of Employment Exchanges rose from 2,495,257 to 2,549,004 in February, and fell in the next month to 2,520,394. Returns from trade unions with a membership of over three and a-half

millions indicated a percentage of unemployment falling from 22.6 at the end of January to 22.0 at the end of February, and further to 21.4 a month later, as compared with 5.8 at the end of March, 1925. In the case of Norway, the trade union percentage of unemployment at the end of March stood at 24.1, as compared with 22.9 a month before and 7.1 a year before. For Swedish trade unions, returns are quoted by the *Labour Gazette* for the same dates; here the figure was 14.7 per cent. at the end of March, as compared with 14.4 per cent. a month before and 12.0 per cent. at the end of March, 1925. Returns supplied to the Danish Statistical Department by trade unions and by the Central Employment Exchange indicated 28.3 per cent. of trade union members as unemployed on February 26; on March 26 this proportion had fallen to 23.2 per cent., as compared with 14.7 per cent. on the corresponding date in 1925.

In Canada the index-number of employment, based upon returns received by the Dominion Bureau of Statistics from over 5,700 firms, employing approximately three-quarters of a million of workers, rose from 90.7 on February 1 to 91.5 on March 1, and then fell slightly to 91.4 on April 1; this last figure compares with 87.2 on April 1, 1925. The monthly report on employment issued by the Federal Department of Labor Statistics at Washington is now based upon returns received from over 9,700 establishments in 53 industries and covers nearly three million workers. In February there was an increase of 1.1 per cent. in the numbers employed, and in March there was a further increase of 0.6 per cent. Aggregate wages paid showed increases of 4.2 per cent. and 0.2 per cent. respectively in these two months. If the monthly average index-number of employment in manufacturing industries in 1923 be taken as 100, the corresponding index-number for March, 1926, was 93.7, as compared with 92.3 in March, 1925.

A reprint of Irving Fisher's *Mathematical Investigations in the Theory of Value and Prices* will be welcomed by all those interested in his work. The memoir, originally published in 1892, was written by Professor Fisher as a thesis for his Degree of Ph.D. in Yale University. A French translation was made by Jacques Monet in 1917.

Members of the Society will be interested to learn that Sir Josiah Stamp, one of the Society's Honorary Secretaries and Editors of the

Journal, has been elected an Honorary Fellow of the American Statistical Association, the senior unofficial statistical body of the American continent, and which counts among its members many eminent in statistical science.

The Senate of the University of London have appointed Dr. Major Greenwood, one of the Society's Honorary Secretaries and Editors, to the Chair of Epidemiology and Vital Statistics tenable at the London School of Hygiene and Tropical Medicine. As the new school building will not be completed before 1928, the appointment is post-dated to August 1, 1928.

The late Professor A. A. Tschuprow's friends and former pupils are collecting materials for an authoritative biography, and to this end will be glad to receive originals or copies of his letters. Any such letters sent to the Assistant Secretary of the Society will be forwarded to the Executive Committee of the Russian Statistical Congress, or they may be sent direct to V. M. Obukhoff, Chairman, Executive Committee, Statistical Congress, 10 Spaso-Peskovskaya Place, Moscow, Russia.

Our readers are probably aware that an Association has been formed to assist in making available to all who wish to use it the scientific and other special information now available in periodicals and libraries. Associate Membership is open to anyone interested. With the assistance of the Carnegie United Kingdom Trust, this "Association of Special Libraries and Information Bureaux" has undertaken, as one of its fresh activities, the compilation of a directory of sources of specialized information in Great Britain and Ireland. Mr. G. F. Barwick, late Keeper of Printed Books at the British Museum, whose scholarship and long experience will be invaluable for such a task, has undertaken the work of General Editor.

OBITUARY.

ALEXANDER ALEXANDROVITCH TSCHUPROW.

Formerly Professor of Statistics, Petrograd.

PROFESSOR A. A. TSCHUPROW, who died at Geneva on April 19 last at the early age of 52, was a brilliant worker in the field of mathematical statistics. His death, like those of Liapounoff and Markoff, was accelerated by the hardships in which the Russian Revolution involved many of Russia's most prominent scientists. He was born in 1874. His father, A. I. Tschuprow, was an economist of note, Professor of Political Economy at Moscow and editor of a Liberal newspaper—*Russkiya Vedomosti*. His grandfather was a village priest. As was the case with many Russian middle-class families fifty years ago, Tschuprow's early education was conducted at home by members of his family and visiting teachers. As a child he showed great aptitude for arithmetic, but his progress at Greek and Latin was still more striking. His school days at the gymnasium, which he entered at the age of fourteen, were not happy. The low moral tone of his schoolfellows and the reactionary tendencies of his teachers were a shock to the sensitiveness of a boy brought up in the family circle of a Liberal publicist.

When in 1892 he entered the mathematical faculty at the University of Moscow, his mind was made up that he was to learn mathematics as an instrument for the study of social phenomena. Jevons' *Principles of Science* accompanied him, to be constantly read and re-read. Tschuprow's thesis for his first degree, the logical foundations of the theory of probability, was significant of the direction his future work was to take. After graduating at Moscow in 1896 he studied in Germany—first in Berlin and Göttingen—where he met great encouragement from Bortkewitch, who introduced him to Lexis. The latter's influence on the young Russian statistician was considerable. Tschuprow's researches on the stability of statistical series and the associated problem of sampling owed their initiative to him. The years from 1897 to 1901 were spent at Strasbourg University, where his teachers were Bortkewitch, Sartorius, and Knapp. Knapp was apparently a strict teacher with severe views on the need of exact reasoning and exhaustive analysis as well

as clear exposition. To his training Tschuprow owed much, and his first important investigation, "Die Feldgemeinschaft eine morphologische Untersuchung" was carried out under Knapp's supervision.

Tschuprow returned to Russia, graduated in Law, and in the autumn of 1902 commenced his teaching career as *docent* at the Polytechnic Institute at St. Petersburg. The Polytechnic Institute was a creation of M. Witte. Those were its early days, but some of the best Russian minds were already on its staff. Tschuprow was one of the most active in organizing the Department of Economics. It was his duty to lecture on general statistical theory to first-year men. He found this a difficult and exhausting task. In later years he never got over his feeling of stage fright when lecturing to large classes of elementary students, although he had less difficulty with senior classes. Much of his time was devoted to the organization of a statistical bureau and the collection of an exceptionally fine library of great scientific value. But most of all he was occupied in conversations with his students and in guiding their statistical research work. When the pressure of the work of organization at the Polytechnic relaxed, Tschuprow was able to complete his "Outlines of Statistical Theory," a dissertation for which he was awarded the doctor's degree at Moscow. It is impossible to over-emphasize the influence of this work on the development of statistical method in Russia: the clearness of the exposition brought the subject within the compass of every intelligent statistician, even if lacking any special training in mathematics and logic, while its breadth of outlook and its incisive analysis gave the reader a feeling of confidence in his mastery of the subject. Russian statistical investigations are characterized by the importance attached to mathematical methods, more so perhaps than elsewhere, and Tschuprow's Outlines have gone far to provide the necessary foundations.

Tschuprow's scientific work gained much from his constant discussions, orally, during vacations, and by correspondence at other times with his father, the economist.

A. A. Tschuprow early formed regular habits, to which he adhered strictly throughout his life. These were necessitated by a feeble constitution which would have proved unequal to heavy and continuous mental effort without them. He was a lover of poetry and art, particularly the works of the Italian School. Tschuprow was passionately fond of music. As a young man he learnt to play the piano, but gave it up when convinced that it would interfere with his scientific work. 1909 marked the commencement of a new period in his work. His interest in economics and the associated statistical

problems gave place to an intensive study of statistical methodology and of the statistical problems that were arising from the applications of statistics to biology and physics. He began to read the work of the English biometricians. The first researches belonging to this period were embodied in his paper on the Law of Large Numbers, read before the St. Petersburg Academy of Science in 1912 on the occasion of the bicentenary of the law, and in the report on the Sex-Ratio problem made to the International Statistical Institute in 1913. It is of interest that this last paper contains almost no mathematics, although it is based on a hypothesis which was itself an elaborate piece of mathematical analysis.* This was followed in 1916 by his first study of the method of Mathematical Expectation, a paper entitled the "Mathematical Expectation of the Coefficient of Dispersion," also read before the Academy of Science.

In May, 1917, he, as usual, went abroad for the long vacation. He never returned to Russia, preferring to wait abroad for the issue of the revolution. His home was broken up, but his letters and manuscripts were saved, as well as his library, which was transferred to the Statistical Bureau.

Tschuprow's first years of exile were spent in Scandinavia. When the opportunity came of entering Germany he went first to Berlin. But in Berlin he found too many friends and lacked the peace and quietness he needed for his work. So he moved to Dresden, where he lived the life of a hermit, seeing only occasionally the few who, passing through Germany, visited his modest retreat. On the whole, and in spite of financial embarrassment, he succeeded in creating an atmosphere suitable for his work, and devoted himself to what had become his life-work, the building up of sound logical foundations for theoretical statistics, applied to the theory of dispersion as developed by Lexis and to the theory of correlation as developed by Pearson and the English School. Much of the work of this period is still unpublished. Gradually his material position worsened. His small savings melted away, and with many misgivings he accepted the offer of a Chair at Prague. Shortly before this, in the words of the Russian correspondent to whom the present writer is indebted for most of the material in this note, "fortune once more smiled on Tschuprow. His election as an Honorary Fellow of the Royal Statistical Society was one of the really joyful occasions in his life."

The move to Prague proved to be a serious mistake. He was unable to arrange for himself that quiet, regular mode of life which

* Some account of this paper is given incidentally by E. M. N. in her review of a work on Sex-Ratio in the March issue of the *Journal*.

had become essential for productive research work. The town was noisy; he was unable to sleep. He did not get on well with the people he met. Relations with many were strained, and his little stock of nervous energy was rapidly dissipated. His heart had been affected by rheumatism in childhood, and the soil was thus prepared for the endocarditis, which first showed itself at the Rome meeting of the International Statistical Institute in 1925. In November last Tschuprow made his last move—this time to stay with old friends in Geneva. His condition grew gradually worse and he died on April 19 last.

L. I.



STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS.

UNITED KINGDOM—

Accountants' Magazine. April, 1926.—The standard wage and labour discontent : *Lightbody (W. M.)*.

Bankers' Magazine—

April, 1926—Rating and valuation : *Brunton (John)*.

May, 1926—Bank of England monetary policy. The inner significance of foreign exchange rates : by *Merchant Banker*. Banking and monetary conditions in England and the United States : *Crump (Norman)*.

Eugenics Review. April, 1926—Sterility and vitamen deficiency : *Parkes (A. S.)*. Baye's theorem : *Fisher (R. A.)*.

Faculty of Actuaries, Transactions of—

Vol. XI, Part I, 1926—A new type of summation graduation formulæ related to Whittaker's Analytical Formula : *Davidson (Andrew R.)* and *Reid (A. R.)* Demonstration of some properties of Whittaker's Method of Graduation. The accurate solution of the difference equation involved in Whittaker's Method of Graduation, and its practical application : *Aitken (A. C.)*.

Vol. XI, Part II, 1926—The theory of selection : its history and development : *Buchanan (James)*, D.Sc.

Financial Review of Reviews. April-June, 1926—Municipal extravagance and its effect on industry : *Wright (Arnold)*. Industrial and financial Germany : *Good (E. T.)*.

Institute of Actuaries, Journal of. March, 1926—Some notes on the changes made by the new Law of Property Acts, with special reference to life assurance practice : *Houseman (David)*.

Institute of Bankers, Journal of. May, 1926—The London and New York markets in the autumn of 1925 : *Crump (Norman)*.

Ministry of Agriculture, Journal of. May, 1926—The utilisation of sugar beet by-products : *Woodman (H. E.)*, Ph.D., D.Sc.

Public Administration. April, 1926—The relations between State departments and the nation : *Ellis (H. H.)*.

Public Health. April, 1926—Some aspects of child welfare work in the United States and Canada : *Cassie (Ethel)*, M.D.

Royal Agricultural Society of England, Journal of. Vol. 86. 1925—A study of the sugar-beet position : *Bridges (A.)* and *Dixey (R. N.)*. Some causes and effects of changes in prices of farm produce : *Ashby (A. W.)*.

UNITED KINGDOM—*Contd.*

Royal Sanitary Institute. Journal of—

April, 1926—Town planning and improvement areas : *Marsden (F.)* and *White (Frank)*. The present type of smallpox : *Dingle (C. V.)*, *M.D.* Child welfare centres and their adjuncts : *Kaye (J. R.)*, *M.B.* Child welfare centres and their adjuncts : *Gall (Helen M.)*, *M.B.*

May, 1926—Some aspects of the housing problem : *Clews (C. A.)*.

Surveyors' Institution. Journal of. April, 1926—Some features of modern mineral legislation : *Rhys (J. P.)*.

UNITED STATES—

American Academy of Political and Social Science, Annals of. May, 1926—A series of articles by various authors on modern crime : its prevention and punishment.

American Economic Review. March, 1926—A note on elasticity of the currency : *Anderson (M. D.)*. Cassel's theory of pricing : *Wolfe (A. B.)*.

American Statistical Association, Journal of. March, 1926—The statistical allocation of joint costs : *Crum (W. L.)*. Construction of an index-number of bond yields in the United States, 1859 to 1926 : *Macaulay (Fred R.)*. Reliability of a percentage : *Hart (Hornell)*. Price-making forces in cotton markets : *Killough (Hugh B. and Lucy W.)*. Combining the advantages of first-difference and deviation-from-trend methods of correlating time series : *Smith (Bradford B.)*. An index of British business cycles : *Thomas (Dorothy S.)*.

Land and Public Utility Economics, Journal of. April, 1926—A study of the motor-bus as a competitor of the railroads : *Slater (J. E.)*. The city housing corporation and "Sunnyside." *Ely (Richard T.)*. Rent and interest as shares in the product of enterprise : *King (Willford I.)*.

Journal of Political Economy. April, 1926—The fallacy of a capital levy : *Sickle (John Van)*. The purchasing-power parity theory : *Terborgh (G. W.)*.

Quarterly Journal of Economics. May, 1926—Partial elasticity of demand : *Moore (Henry L.)*.

Review of Economic Statistics. April, 1926—Revision of the index of general business conditions : *W. M. P., W. L. C. and E. F.* Wholesale prices in the United States, 1825-45 : *Cole (Arthur H.)*. Deflated dollar-value series as measures of business : *Snyder (Carl)*.

ARGENTINA—

Revista de Ciencias Económicas—

January, 1926—La situación económica de Rusia y las perspectivas de sus mercados en 1923 : *Linares (José Mujías)*.

February, 1926—La situación económica de Irlanda : *Godoy (Juan Carlos)*.

ARGENTINA—Contd.

Revista de Ciencias Económicas—Contd.

March, 1926—La marina mercante argentina : *Badaracco (Juan)*. La industria del café en Colombia : *Ancizar (Jorge)*.
 April, 1926—La legislación del trabajo en la Argentina : *Palacios (Alfredo L.)*. Cuestiones agrarias : *Coni (Emilio A.)*.

DENMARK—

Nationaløkonomisk Tidsskrift. 1ste-2det Hefte, 1926—Konkurren-
 cen for danske Landbrugsprodukter paa det engelske Marked :
Faber (Harald). En "managed currency" : *Bech (Gustave Ole)*.
 Forbruget i kopenhavnske Familier ; *Heiberg (Povl)*.

EGYPT—

L'Egypte Contemporaine. February-March, 1926—Le régime fiscal
 égyptien et les capitulations : *Ismail Sidky Pacha (S. E.)*. La
 fertilité de l'Égypte : *Mossiri (Victor M.)*.

FRANCE—

Bulletin de Statistique et de Législation Comparée. December,
 1925—Les taxes assimilées aux contributions directes en 1924.
Journal de la Société de Statistique de Paris. April, 1926—Méthodes
 à suivre pour la préparation des statistiques des stocks (*fin*) :
Methorst (H. W.). Prévisions relatives aux paiements en nature
 des réparations et des dettes interalliées (*fin*) : *Yves-Guyot*. La
 situation financière et l'achèvement de la reconstitution des
 régions dévastées au 31 décembre 1925 (à suivre) : *Michel (Edmond)* (*continued in May number*).

Journal des Economistes—

April, 1926—La "cyclicité" de la vie économique et de la
 politique économique éclairée par l'exemple de l'évolution
 japonaise de 1868 à 1925 dans ses rapports avec l'étranger :
Fukada (Tokuzo). Les obstacles à l'évolution économique :
Yves-Guyot. La dette française aux Etats-Unis : *Legros (J.-B.)*.

May, 1926—La Sarre et la Rhénanie : *Lémonon (Ernest)*.

La Réforme Sociale—

March, 1926—La taxe d'apprentissage : Communication par
Lacoin (M. Maurice).

April, 1926—Deux exemples d'effondrement de monnaie
 nationale : *Zvorikine (Nicolas)*.

Revue d'Economie Politique—

January-February, 1926—La loi de la demande individuelle
 et la rente de consommateur : *Ricci (Umberto)*. La situation
 économique en Allemagne d'après les banquiers allemands :
Grinberg (M.). L'indice monétaire et la théorie de la monnaie
 (*suite et fin*) : *Divisia (François)*.

March-April, 1926—A series of articles by various authors
 on the movement of population, the movement of prices,
 finance, trade, production, and transport and labour.

GERMANY—

Weltwirtschaftliches Archiv. April, 1926—Der Begriff der Weltwirtschaft. I.: *Harms (Dr. Bernhard)*. Wirtschaft und Geopolitik: *Vogel (Dr. Walther)*. Die Bedeutung der überseeischen Märkte für Europa: *Fraenkel (Dr. A.)*.

Zeitschrift für die gesamte Versicherungs-Wissenschaft. April, 1926—Die gegenwärtigen Probleme der Sozialversicherung: *Grieser (Andreas)*. Statistik und Wahrscheinlichkeiten über deutsche Rechtsanwälte: *Schweer (Dr. Wilhelm)*. Die versicherungsrechtliche Obliegenheit: *Bruck (Dr. Ernst)*.

ITALY—

Annali di Economia. May, 1926—Contributo alla teoria economica dei beni succedanei: *Fanno (Marco)*.

Giornale degli Economisti e Rivista di Statistica—

March, 1926—L'offerta del risparmio: *Ricci (Umberto)*. Il costo quale elemento della teoria economica: *Vecchio (Gustavo del)*.

April, 1926—Appunti critici sul protezionismo marittimo e su alcune sue forme storiche: *Federici (Luigi)*.

May, 1926—Aspetti e problemi dell'economia italiana: le industrie del cotone in Italia: *F. P.* Sulle medie di potenze: *Bonferroni (C. E.)*.

Giornale di Matematica Finanziaria. February, 1926—Metodo dei gruppi e sistema di controllo per il conteggio delle riserve di premio delle assicurazioni vita: *Zaula (F.)*. Sulle rendite, le costituzioni di capitali e gli ammortamenti in generale: *Lenzi (E.)*. Sei anni di esperienza dell'assicurazione obbligatoria contro gli infortuni in agricoltura: *Insolera (F.)*.

La Riforma Sociale. March-April, 1926—Il primo anno di applicazione del piano Dawes: *Bresciani-Turroni (C.)*. Le prime basi teoriche della finanza dello stato democratico: *Rossi (Ernesto)*. Rivalutazione e stabilizzazione della lira: *Rosselli (Carlo)*.

SWEDEN—

Ekonomisk Tidskrift. Häft 2-3, 1926—Tyska skadeståndsproblemet: *Davidson (David)*. Den engelska kolkrisen: *Hildebrand (Karl)*.

Nordisk Statistisk Tidskrift—

Band 4, Häft 4, 1925—Den svenska stadsbygdens folkmängd: *Zetterberg (Otto)*. Yrkesundervisningen i Sverige: *Dahn (Paul)*. Jordbruksstatistikens omorganisation i Sverige: I.

Band 5, Häft 1, 1926—Economic and financial conditions in Norway: *Rygg (N.)*. Jordbruksstatistikens omorganisation i Sverige: II. The Norwegian harvest statistics and their rearrangement: *Skappel (S.)*. The wood products of the Swedish export trade: *Anstrin (Hans)*.

SWITZERLAND—

Journal de Statistique et Revue Economique Suisse. Fasc. 1, 1926—
Möglichkeit und Wirklichkeit in der Wahrscheinlichkeitsrechnung und Statistik: *Schenker (Dr. O.)*. Der materielle Wert der menschlichen Arbeitskraft: *Thalmann (Dr. W.)*. Basler Sterbetafel nach dem Bevölkerungsstand der Jahre 1918–1924: *Stohler (Dr. H.)*.

INTERNATIONAL—

International Labour Review—

April, 1926—The American labour movement and scientific management: *Devinat (Paul)*. The compilation of wages statistics: *Ricci (Umberto)*. Industrial inspection in Germany in 1923 and 1924. Industrial diseases: analysis of Factory Inspection Reports, 1920–2: III.

May, 1926—The human factor and industrial accidents: *Vernon (Dr. H. M.)*. The problem of labour output in Soviet Russia. Child labour in German agriculture during the last twenty years.

LIST OF ADDITIONS TO THE LIBRARY.

Since the March, 1926, issue, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom and its several Divisions.

United Kingdom—

Memorandum on the influence of legislative and administrative changes on the official unemployment statistics. Cmd. 2601. 9 pp. London, 1926. Price 3*d.* net. (H.M. Stationery Office.)

Labour, Ministry of. Report on an enquiry into the personal circumstances and industrial history of 3,331 boys and 2,701 girls registered for employment at employment exchanges and juvenile employment bureaux, June and July, 1925. 80 pp. London, 1926. Price 1*s.* 9*d.* net. (H.M. Stationery Office.)

Overseas Trade, Department of. Reports on conditions in Belgium, February, 1926; Bolivia, October, 1925; Chile, September, 1925; Costa Rica, 1925; East Africa, September, 1925; Grand Duchy of Luxemburg, 1926; Guatemala, 1924–25; Honduras, 1924–25; Newfoundland, 1925; Panama, 1925; Philippine Is., June, 1925; El Salvador, 1924–25; Uruguay, November, 1925. (The Department.)

England and Wales—

Industrial Fatigue Research Board :—

Report No. 36. On the design of machinery in relation to the operator. By *L. A. Legros* and *H. C. Weston*. vi + 34 pp. London, 1926. Price 1*s.* 3*d.* net. (The Board.)

(b) India and Dominions.

India—

Report on the age-distribution and rates of mortality deduced from the Indian census returns of 1921 and previous enumerations. By *H. C. W. Meikle*. 52 pp., fol. Calcutta, 1926. Price 5*s.* (Government of India.)

Australia—

Census, 1921 :—

Part XXVII. Life tables. pp. 1837–1889. Fol. Melbourne, 1925. Price 2*s.* 6*d.* (Census Bureau.)

Part XXVIII. Families. pp. 1893–2012. Fol. Melbourne, 1926. Price 2*s.* 6*d.* (*Id.*)

Report of the Royal Commission on Health, together with appendices. 118 pp., fol. Price 2*s.* 9*d.* (The Commission.)

Canada—

Old-age pension systems existing in various countries. Issued as a supplement to the Labour Gazette, March, 1926. 15 pp. Ottawa, 1926. (The Department of Labour.)

Manufactures of the non-metallic minerals in Canada, 1925. 2 sheets. 1926. (The Bureau of Statistics.)

(b) **India and Dominions—Contd.****Ceylon—***Colombo—*

First report on the preliminary census of poverty in the city of Colombo.
By *L. J. B. Turner*. 24 pp., fol. Colombo, 1926. (The Author.)

Union of South Africa—

Science Bulletins Nos. 43 and 46. Pretoria, 1926. (The Department of Agriculture.)

Science Bulletin No. 44. A biometrical analysis of merino wools. Prof. *J. E. Duerden* and *V. Bosman*. 16 pp. Pretoria, 1926. (*Id.*)

(c) **Foreign Countries.****Belgium —**

L'Industrie, du Travail et de la Prévoyance Sociale, Ministère de. Rapports sur la réparation des dommages résultant des accidents du travail, 1921-1922-1923. 187 pp. Bruxelles, 1925. (Ministère de l'Industrie.)

Bern—

Beiträge zur Statistik der Stadt Bern, Heft 7. 109 pp. 1926. (Statistisches Amt.)

Brazil —

Progrès de l'immigration italienne au Brésil. Par le Dr. *Bulhões Carvalho*. 21 pp. Rio de Janeiro, 1925. (The Author.)

Aperçu sur les résultats du recensement réalisé au Brésil en Septembre, 1920. Par Dr. *Bulhões Carvalho*. 50 pp. Rio de Janeiro, 1925. (The Author.)

China—

The index number of customs import prices in Shanghai. 24 + 18 + 2 pp. Shanghai, September, 1925. Revised edition. (Shanghai Bureau of Markets.)

Czecho-Slovakia—

Résultats du relevé statistique des forêts dans la République Tchécoslovaque d'après l'état en 1920. xx + 32 + 131 pp. and 9 tables. Prague, 1925.

Price 40 C. tch. (L'Office de Statistique.)

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SOME OBSERVATIONS ON TRADE FORECASTING AND PRICES

By E. C. SNOW, M.A., D.Sc.

[Read before the Royal Statistical Society, June 15, 1926,
the President, Mr. G. UDNY YULE, C.B.E., F.R.S., in the Chair.]

RECENT discussions upon trade forecasting and business barometers have placed such an emphasis upon the significance of monetary factors in determining the trend of trade, that a few observations aimed to throw some little light upon the importance of these factors in relation to other factors in determining movements in prices and trade activity do not seem to be out of place. The most positive statement on the subject is probably that which is published quarterly by the Federation of British Industries, and which is worth quoting in detail :—

“ Our Business Barometer, which is published at quarterly intervals, is constructed on the basis that any important alteration in the state of trade is preceded by an alteration in the rate of flow of money between the banks and trade, and observable changes in the money market. Since, as a rule, changes in monetary conditions precede alteration in the state of trade, we believe that by studying the movements of the money market and the actions of the banks, it is possible to forecast ahead, with a fair degree of certainty, forthcoming changes in business conditions. Broadly speaking, we may describe the trade of the country as

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being carried on by the circulation of a comparatively limited stock of money which flows to and fro between the banks and the innumerable channels of industry and commerce. The smallness of the amount of money employed in comparison with the number of transactions which it is called upon to finance, makes it essential that, if trade is to run smoothly, it should be kept circulating continuously; that is to say, its employment in any one transaction must only be *temporary*. Any interruption or change in the rate of flow of money has, therefore, very important reactions on business transactions, especially during a period of active trade.

“The industrial history of the last century shows that trade does not proceed smoothly, but by a series of alternate ebbs and flows: periods of prosperity alternating with periods of depression, the former being characterized by an increase in production, rising prices, high profits, good employment, increasing wages, high interest rates, and falling bank reserves; the latter by a decrease in production, falling prices, low profits, unemployment, low interest rates, and rising bank reserves. Changes in the rate of circulation of money have been a marked feature of these fluctuations, which are commonly referred to as ‘trade-cycle movements.’ We find, for example, that the culmination of an upward movement was invariably accompanied by a sharp rise in the Bank rate, which stopped or slowed down the rate of circulation of money to such an extent as to compel manufacturers and merchants—whose business operations are dependent on a continuous supply of borrowed money—to reduce the scale of their operations. This meant that they not only ceased adding to their stocks, thus bringing about a slowing down of production, but also took steps to unload existing stocks at a faster rate than they would normally have been absorbed by the market. The former, by reducing profits and earnings, caused the purchasing power of the country to fall off, and the latter, by overloading the market, accelerated the fall in prices; the cumulative effect being to produce a depression in trade if the movement was at all widespread.

“The above must not be taken as implying that the only influence determining trade-cycle movements is money, for there are instances of fairly definite expansions and contractions of trade unaccompanied by any very marked alteration in monetary conditions. There can, however, be no doubt that money was one of the outstanding influences in the major pre-war international fluctuations.”

As against this view of professional industrialists upon the function of the banks which regulate the flow of money may be set the following statement by Mr. Leaf, the Chairman of the Westminster Bank, at the last annual meeting of the shareholders of that bank :—

“The banks are not the engine which drives the car, as some of the ill-instructed would have us believe; they are no more than the lubricating system, which is engaged in seeing that each member of the complicated machine has its proper supply of the oil which enables it to run smoothly. For ‘the banks,’ if I may continue the comparison, have nothing to do with the supply of petrol, the fixed capital of industry which is the driving force on which all depends: they can, at most, give advice and assistance to those who desire to place their money in fixed investments.”

The Federation of British Industries recognizes the existence of other factors which are auxiliary to the main factor—supply of money. Mr. Leaf, on the other hand, recognizes the monetary factor as one accessory to other factors. I have always had difficulty in accepting completely the former view, based upon reasoning somewhat as follows :—Trade as a whole is made up of the trade of many component industries. It is admitted that there is a common factor (the monetary factor) operative throughout all the components, but in addition each component is influenced by factors peculiar to itself. In any particular industry the combined effect of these specific influences altogether outweighs that of the monetary factor, and the criterion adopted to indicate variations in activity in that industry (*e.g.* index of unemployment) will not reflect the movements of the monetary factor in any marked degree. This is probably true of most industries taken separately. The non-monetary factors are of more importance in determining the activity of the individual industry than are the monetary ones, these non-monetary factors being different for the different industries. Yet when a resultant is obtained for trade as a whole by combining the indices for the individual industries and the effect of the specific factors is masked, the variation in the index for trade as a whole is assumed to be due to the monetary factor, on the ground that this is common to all industries. I do not think that anybody directly concerned with the Shipbuilding industry would say that the monetary factor, though not without effect, had any really important influence in connection with the variations in prosperity of that industry in recent years. Nor would the increase in unemployment in Coal-mining (from 2.0

per cent. in April, 1924, to 22.2 per cent. in August, 1925) be ascribed, at any rate to more than a very small extent, to the operation of monetary factors. I have not noticed that anybody engaged in the Cotton industry, in attempting to explain the reasons for the variation in the prosperity of that industry in recent years (unemployment fell from 21.5 per cent. in August, 1923, to 6.8 per cent. in February, 1925, rising again to 13.6 per cent. in August of the same year, with a substantial fall since), has expressed the view that monetary factors played a part of any real importance in comparison with the specific factors associated with the Cotton industry. Nobody in the Leather industry would say that considerations relating to the supply of money were of importance in creating the world-wide depression which has occurred in that industry. Similar statements can probably be made with regard to the Engineering, Jute, and many other industries. Why, then, should money be assumed to be so important a factor when discussing industry as a whole?

In some instances partial failure of a crop creates substantial effect upon the activities of an industry, altogether outweighing the effect of general monetary factors. Such was the case with the Jute industry in the past year. In the case of the Cotton industry, one of the most patent troubles causing recent depression was that of over-production of cotton manufactures. Owing to the loss of export trade, the capacity of the machinery has been much greater than the consumptive demand for the product. The depression has been caused largely by the reaction following a period in which all manufacturers have scrambled to get such a share of the limited business available as would keep their machinery occupied. The process of determining the least efficient units by the process of natural selection in modern industry is slow, and while it is operative it overshadows monetary factors in fixing the activity of the industry. Even during the recent period of unparalleled general prosperity in industry in the United States, certain individual industries were in the throes of unprecedented depression. The most noteworthy of these was the Heavy Leather industry, the heavy losses and decreased production in this being in marked contrast to the general position in that country. Here, owing to the loss of very substantial export trade, the industry found itself with a capacity for production about 50 per cent. in excess of its ability to sell. Huge stocks accumulated, followed by the closing down of plant at a time when the monetary lubricant was being very freely applied. Indeed, the abundance of the lubricant actually accentuated the trouble and delayed the period of reconstruction. Instances could be quoted where the lubricant was applied in cases where it was hopeless to

expect the machinery to function. One of the real troubles of the close association between industry and banks under existing circumstances is that the banker is in a position to use the lubricating can without having the specialized training to know when and where it should be applied.

It seems difficult to accept the view that what is not true of each individual industry is of great importance in considering industry as a whole. It is agreed that there is a factor common to them all—the monetary factor—but it does not seem to be justifiable to assume that this factor, which happens to be common to all, is the really important one which in itself produces variations in industry as a whole, and therefore also in the constituent industries. My observations on this matter refer to the circumstances existing in the last three or four years, and not to periods when the variations in the supply of money were abnormal, *e.g.* between 1917 and 1921.

The analogy of lubrication may be used to illustrate the argument. It is admitted that proper lubrication is a necessary factor for the successful functioning of sewing-machines, bicycles, motor-cars, steam-locomotives, and aeroplanes, to mention only a few types of machine. In each case, however, there are many other factors operating which, in the individual case, are more important than the lubricant—for example, the hand turning the wheel of the sewing-machine, the foot turning the pedal of the bicycle, the petrol in the motor-car, and the steam in the locomotive, etc.—and none of these factors is common to all. Nobody claims that the factor which is common to all—lubrication—is the really potent force which makes all machines function. Neither are we justified, accordingly, in assuming that the factor which is obviously common to all industries is the really potent one in determining the motion of the industrial machine. If industry could be carried on without money there would certainly be fluctuation in industrial activity, and it would not be difficult to adduce theoretical reasons for the view that the use of money tends to smooth out industrial fluctuations as much as it tends to cause such movements.

It seems probable that the monetary factors are relatively less important in comparison with the other factors in producing fluctuations in industrial activity in the case of a country like Great Britain, where foreign trade bears a substantial proportion to total trade, than in other countries which are more self-contained. The Cotton industry in this country, for instance, for which the proportion of export trade is much larger than for any other important industry, pays more attention to events in India and China—quite unconnected with our monetary policy—than to the ease or stringency of the

money market. The Boot industry, which before the war had a substantial export trade, has lost a great part of that trade, because most of the countries which took our boots have now determined to make their own, and have used the tariff wall as the means to do so. At the present time no amount of easy money would enable manufacturers to get over these walls; and tariff policy in Australia, South Africa, Argentine, and other countries is of more interest to many boot manufacturers than is monetary policy in this country.

As these observations are intended to have reference to trade forecasting, some remarks about the future of the so-called "export industries" are not out of place. It seems to be assumed by some people connected with certain of those industries that their return to the same amount of export business that they had before the war is essential in order that the country can continue to import its foodstuffs and raw materials. This view fails to take proper account of our "invisible exports," and the fact that we can maintain our balance of trade, and are indeed tending to do so, by increasing "invisible exports" relatively to exports of merchandise. The following figures show for certain years (1) the net imports of merchandise, (2) the exports of British merchandise, and (3) the Board of Trade's statement of the "Total Invisible Exports on Balance":—

[Million £.]

	1910.	1913.	1923.	1924	1925.
Net imports of merchandise	£ 374	£ 659	£ 979	£ 1,137	£ 1,168
Exports of British Merchandise	430	525	767	801	773
Invisible exports	*	*	373	415	429

* The figures for these years on the same basis as those for the more recent ones are not available.

Assuming (it is not quite accurate, since some of the imports are raw materials required to produce manufactured goods for export) that we must have our imports to maintain our standard of living, the extent to which our exports of merchandise pay for these has been as follows:—

	Per cent.		Per cent.
1910	75	1924	70
1913	80	1925	66
1923	78		

Before the war, the tendency seems to have been for our exports of merchandise to be increasing in importance as the means of payment of our necessary imports. In recent years, however, the movement has been reversed. The imports have not been diminished, but they are being paid for to a greater extent by "invisible" exports. The "invisible" and "visible" exports are to some extent in competition in paying for the necessary imports, and under present circumstances the "invisible" people are getting the business. We may feel that it would be better for twelve men to be engaged in making boots for export rather than that one insurance broker should be making commissions of £5,000 per year on foreign business; but the fact seems to be that those from whom we buy prefer the "invisible" to the "visible" method of payment for their food and raw materials, and we shall have to recognize the fact.

When we examine the argument, developed in earlier paragraphs, with particular reference to wholesale prices, the difficulty of accepting the monetary explanation of the variations in the general wholesale index-number is, to those associated with the details of price movements in individual industries, just as pronounced. The Cotton man tells us that the main reasons for the variations in the price of cotton in recent months have been associated with the crop reports in the United States and with the political and economic circumstances in the East. He does not consider that the monetary factors are of the same order of importance as are these. The Leather man would explain that the reason for the heavy fall in hide prices in recent months is due to the very large accumulation of leather in the United States and to the development in the use of substitutes for leather, neither factor, again, being directly associated with monetary policy in this country. The Jute man would tell us that the upward movement which occurred in the price of jute last year was due to the smallness of the crop in India, and the subsequent fall is largely due to the reaction from this—a factor, again, which is not in any way directly concerned with monetary policy. The Wool man would also give us explanations of the reason for the fluctuations in prices of wool in the past year or two which have little reference to monetary policy, and the story could be continued. Yet, when the "price relatives" for all these individual commodities are combined to form a single index to represent the average experience of them all, it is assumed that variations in this index are due to monetary considerations. If these considerations are secondary in the individual price movements, it is not justifiable to assume that they are of primary importance in the general wholesale price movements.

In this country the only regular data bearing upon the question of variations in industrial activity are unemployment figures. If a single factor were very important in producing variations in industrial activity, the curves showing monthly changes in unemployment in individual industries would be more or less similar, though there might be a lag between the similar movements. The upward and downward movements should, however, more or less correspond. The data for unemployment in individual industries, published monthly by the Ministry of Labour in the *Labour Gazette*, are only available in their present form since June, 1923. The figures for all industries employing more than 100,000 employees have been examined, and to obtain a relatively smooth curve indicating the movements of unemployment, in place of the sequence of percentages actually recorded, a new sequence has been obtained by taking as the value for a particular month the average of the five months of which it is the centre. It is confusing to set out the line for each of the 23 industries on one diagram, but an indication of the lack of uniformity in the recent movements can be shown in the following way. Representing the maximum point in a movement by T, and the minimum by B, the general features of the curves are as shown on p. 643.

In the early months of the period under review (following a time of very pronounced deflation) most of the curves had a downward tendency, though the two biggest industries (Coal-mining and the Distributive trades), accounting for 23 per cent. of all, did not conform to this. Quite a number of the curves reached the lowest point between February and August of 1924, though industries representing about 24 per cent. of the total were exceptional in this respect. Subsequent movements, however, have been much more irregular, maxima and minima occurring round about the same time. In the last six months of the period, for example, 7 of the curves showed distinct maxima, 8 distinct minima, while most of the others were approximately horizontal.

The full curves for the 6 largest industries are shown separately in Diagram I, the line representing "All Industries" being shown alongside in each case. The Coal-mining industry was affected by various abnormal factors during the period, but it represented more than 10 per cent. of the total, and was able to make a bigger impression on the resultant curves than any other productive industry. The other curves, however, indicate little relationship to one another. It is inevitable that over short periods there should be some degree of correspondence, but, taken as a whole, there are as many periods of disagreement as there are of agreement. The curves for Cotton and Wool, for example, over a period of twelve months were moving in

	1923					1924					1925					1926				
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	
All Industries		T																		
Coal-mining							B							T						
Steel-melting and Iron-puddling Furnaces, Iron and Steel Rolling Mills and Forges									B					T						
General Engineering; Engineers' Iron and Steel Founding		T																		
Construction and Repair of Motor Vehicles, Cycles and Aircraft																			B	
Shipbuilding and Ship Repairing															T					
Cotton		T																		
Woolen and Worsted		T															T	B		
Textile, Bleaching, Printing, Dyeing, etc									B					T			B			
Tailoring																				
Dress- and Mantle-making and Millinery																				
Boot, Shoe, Slipper and Clog Trades																				
Bread, Biscuit, Cake, etc., Making																				
Drink Industries																				
Furniture Making, Upholstering, etc.																				
Printing, Publishing and Bookbinding																				
Building																				
Public Works Contracting																				
Gas, Water and Electricity Supply Industries																				
Railway Service																				
Tramway and Omnibus Service																				
Shipping Service																				
Canal, River, Dock and Harbour Service																				
Distributive Trades																				

Continuous decline, without cyclical movement.

Practically no movement.

Practically no movement.

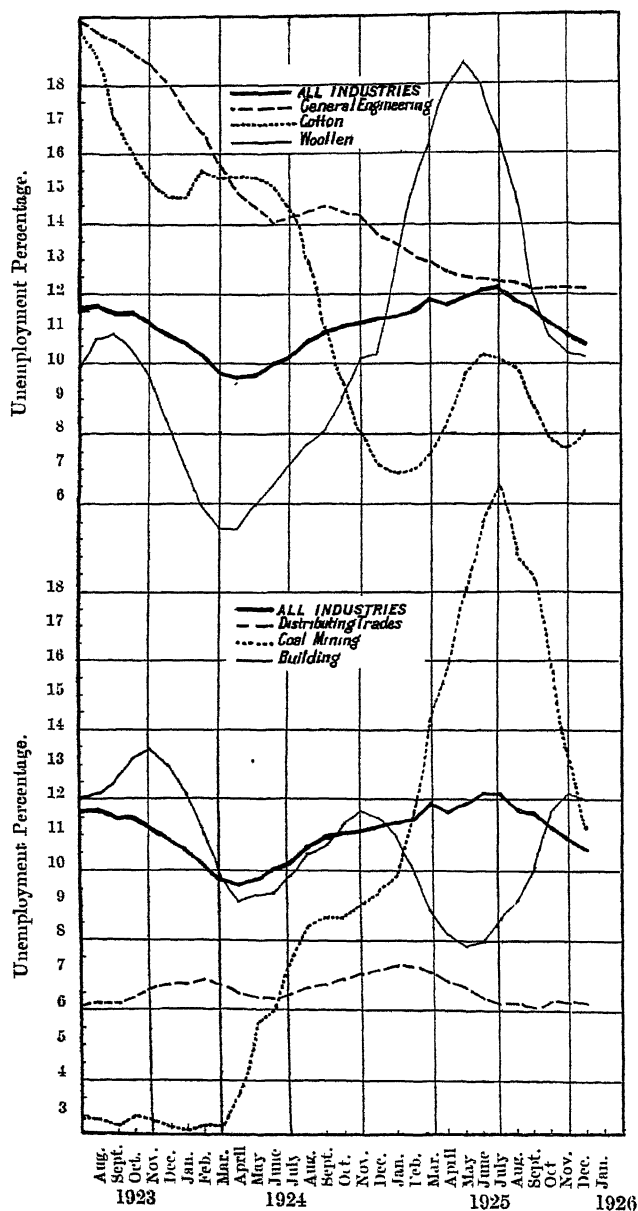
Practically no movement.

Practically no movement.

Practically no movement.

Practically no movement.

DIAGRAM I—UNEMPLOYMENT PERCENTAGES IN THE SIX LARGEST INDUSTRIES.



opposite directions and at a rapid rate. There is nothing in the curves to support the view that some common factor was operative, causing periods of relative prosperity or adversity to all (or most) industries at the same time. The curves are more consistent with the hypothesis that the unemployment of each industry is determined by factors mainly peculiar to itself, and the resultant curve naturally bears the main features of the curves for the most important individual industries. The increase in unemployment in Coal-mining, for instance, between April, 1924, and August, 1925 (caused by factors peculiar to the Coal industry), was so pronounced that it determined a slow rise in the same period in the line for "All Industries," in spite of the fact that the curves for General Engineering, Cotton, Building and the Distributive trades bore no resemblance to that of Coal. An analysis of the figures for such a short period as two or three years is admittedly insufficient for any generalization, but I think it can be maintained on evidence that in the past two or three years the factors which have determined the course of industry have been mainly those peculiar to individual industries and not those associated with all industries.

By means of correlation coefficients it should be possible, however, to get some general idea of the extent to which movements in activity in different industries and movements in commodity prices are influenced by general factors affecting all industries or commodities. The data available may not be altogether satisfactory for this purpose, but it seems to me that those who hold strong opinions of the potency of the monetary factor in modern industry should at least examine all the data available and ascertain what support they give to those opinions. The examination which follows here does not pretend to be exhaustive, but is intended for the purpose of forming some general idea of the extent to which comprehensive factors are operating over industry generally. The analysis deals with (a) commodity prices and (b) indices of industrial activity, and as more data are available for (a) than for (b) the former is dealt with more fully.

The factors determining the price of an article can be summarized under the following three general headings :—

- (1) The factors affecting the general value of money.
- (2) The factors affecting the "short period" use of money.
- (3) The factors specifically associated with the particular article, *e.g.* variations in crops.

The value of money is generally changing continuously, though our means of measuring the change is approximate only. To a first approximation, however, we may assume that this change can be

measured by the long-period variations in any comprehensive index-number of prices. The rise in the annual Sauerbeck Index-number of General Prices from 61 in 1896 to 85 in 1913, for example, indicated a fall in the value of money during that period. If in a statistical investigation we wish to make allowance for the effect of the changing value of money, we should deal with a period over which the general index-number of prices is approximately uniform (though there would be short-period variations), or, in the language of the theory of multiple-correlation, we should correct "for a constant level of general prices."

It is the relative importance of the factors (2) and (3) that are of interest in this inquiry. It is the view of the "monetary school" that the factors (2) are more important than those of (3) in determining short-period movements of price. Based upon the experience, admittedly, of two or three industries only, I had the impression that the influence of the factors under (3) outweigh the influence of the factors under (2), and this inquiry was started to ascertain whether this impression is confirmed on detailed investigation.

If we traced the movements from month to month in the price of one commodity with the corresponding movements in the price of another commodity over a period in which the general level of prices was approximately constant, a high degree of relationship between the two sets of movements would indicate the importance of common factors, such as those referred to in (2), affecting the movements of both. If, on the other hand, there was no relationship between the movements, we should infer that factors (2) were less important than factors (3).

The early correlations worked out related not to individual commodities but to groups of commodities. The Board of Trade publish each month for the United Kingdom index-numbers of wholesale prices under the following groupings:—

- (a) Iron and Steel.
- (b) Other Metals and Minerals.
- (c) Cotton.
- (d) Other Textiles.
- (e) Miscellaneous Materials.
- (f) Total not Food.
- (g) Cereals.
- (h) Meat and Fish.
- (k) Other Foods.
- (l) Total Food.
- (m) All Articles.

Starting from January, 1922, up to March, 1926 they gave the convenient number of 50 observations, and the correlation between the movements from one month to the next in each index and that between the corresponding movement in the others was worked out. Some of these might have been omitted, but in arranging the arithmetical work to ascertain those of chief importance the others were almost automatically determined.

Throughout the period under review the indices all fell on the average, and there was a noteworthy similarity in the decrease in most of them. The average monthly decrease for each group, with the actual index for January, 1922, and the standard deviations of the monthly movements, were as follows :—

	Index, January 1922.	Average Monthly Decrease	Standard Deviation of Monthly Movement
(a) Iron and Steel	149.5	.54	2.92
(b) Other Metals and Minerals	175.7	.38	3.10
(c) Cotton	182.3	.48	7.57
(d) Other Textiles	169.2	.10	4.19
(e) Miscellaneous Materials	146.6	.50	1.94
(f) Total not Food	148.8	.40	2.33
(g) Cereals	180.4	.32	5.34
(h) Meat and Fish	167.4	.50	5.21
(k) Other Foods	172.6	.50	6.63
(l) Total Food	161.2	.38	3.46
(m) All Articles	164.0	.38	2.01

The uniformity in the rate of decrease among the groups is interesting, only one group differing widely from the average for "All Articles"

The variations in the monthly movements, however, were far from being uniform, the "Cotton" group fluctuating to the greatest extent.

The correlations between the monthly movements in each case are as shown on p. 648.

The correlations between the movements in any one group and those in another group which includes the first are, of course, substantial, *e.g.* between movements in the "Iron" group and movements in the group "Total not Food" (.81), and again between movements in the "Iron" group and the group "All Articles" (.57). On the other hand, the correlations in those cases where even if the monetary factor were very important its influence would be expected to be relatively small, are insignificant, *e.g.* between

movements in "Cotton" prices and those in "Other Foods" (.00) and between movements in the "Iron" group and those in "Cereals" (.01).

When we examine the correlations between movements in prices for the various "materials" groups, we note some that seem significant, especially that between "Iron" and "Other Metals" (.66). Those between "Other Metals" and "Other Textiles" (.35), and between "Cotton" and "Iron and Steel" (.30), are also of noteworthy significance, though not large. The corresponding correlations between movements in prices for the various "Food" groups are smaller and hardly of definite significance, the largest being that between "Cereals" and "Other Foods" (.24). One or two of the correlations between movements in a "Food" group and a "Material" group are on the border-line of significance, *e.g.* between "Meat and Fish" and "Other Textiles" (.32), and between "Cereals" and "Other Textiles" (.28).

To make allowance for the change in the value of money which occurred during the period we can correct the above correlations by the process of partial correlation for a "constant level of prices." For this purpose we must determine the correlations between the movements in price from one month to the next for each of the groups in turn with the actual value of the price index for all articles for the earlier of the two months. Thus, for example, the movement in any group from January to February is compared with the actual index-number for all articles for January. The correlations thus found are :—

Correlations between Board of Trade Price Index-number for "All Articles" for one month, and movement in index-number from that month to the next in the case of—

(a) Iron and Steel	...	...	—	.170
(b) Other Metals and Minerals	...	...	—	.068
(c) Cotton	...	...	+	.055
(d) Other Textiles	...	...	+	.083
(e) Miscellaneous	...	...	+	.046
(f) Total not Food	...	...	—	.063
(g) Cereals	...	...	+	.217
(h) Meat and Fish	...	...	+	.023
(k) Other Foods	...	...	+	.111
(l) Total Food	...	...	+	.165
(m) All Articles	...	...	+	.056

These correlations are too small to need comment. On the whole, there was little association between the general level of prices through the period and the monthly movements in the price indices of the individual groups.

The partial correlation coefficients can now be determined by the formula

$$r_{12} = \frac{r_{12} - r_{13} r_{23}}{\sqrt{1 - r_{13}^2} \sqrt{1 - r_{23}^2}},$$

the suffixes "1" and "2" denoting the movements in the Index-number from month to month for any two of the groups, and "3" the Board of Trade Price Index for "All Articles." It is clear, however, from the smallness of the correlations in which "3" is concerned, that the change produced by making the adjustment for constancy of general price-level is very small, and that for practical purposes the crude correlations set out above for the various groups represent also the correlations when allowance has been made for the variation in the general price-level. Only one of these correlations is really substantial, namely that between price movements in the "Iron" and that in the "Other Metals" group. There appears to be evidence here of the influence of some factors acting to cause similar simultaneous movements in the prices of "Iron and Steel" and in "Other Metals"; and the correlation is not inconsistent with the view that monetary influences are important in determining fluctuation in the prices of these commodities. None of the other correlations are large enough to justify strongly the view that similar influences are really appreciable in causing variations in the prices of other groups, though on the whole it may be said that there is evidence that such influence exists but is only of slight effect.

It may be claimed, however, that the influence of the common factor would not necessarily be disclosed in the correlations between simultaneous movements in the price indices of two groups, but that there would be a lag between the movements produced by the common factor. The monetary influence which produced a particular change in price of one commodity between, say, January and February, might be most evident in the case of another commodity by a corresponding change between February and March. A few correlations have accordingly been worked out to ascertain if higher values are obtained if allowance is made for different periods of "lag." These correlations are as follows :—

Correlation between movements of price index for "Iron and Steel" group between one month and the next, and movements of price index for "Other Metals" group—

Two months earlier	...	...	...	·14
One month earlier	...	...	...	·53
Simultaneously	...	...	...	·66
One month later	...	...	...	·38

Correlation between movements of price index for "Iron and Steel" group between one month and the next and movements of price index for "Cotton" group—

Two months earlier	...	...	...	·12
One month earlier	...	...	...	·35
Simultaneously	...	...	...	·30
One month later	...	...	...	·05

So far as the "Iron and Steel" group and "Other Metals" group are concerned, no appreciably higher correlation is found by allowing for lag. An increase is found, however, in the case of the correlation between the "Iron and Steel" groups and the "Cotton" group. By interpolation, a maximum value of nearly ·37 is obtained for a lag of about two-thirds of a month, and this increases the evidence of the influence of common factors in determining price movements.

Each of the groups referred to above contains a number of commodities, and it might be that the evidence afforded by the above correlations of the influence of common factors in determining price movements is blurred by grouping, and that it would be clearer if the correlations were determined for movements in the prices of individual commodities. The data for the individual commodities used in the compilation of the Board of Trade Index are not published, but suitable data are published each month by *The Times* and used in the formation of the index-number published by that paper. The data for the following articles have been examined:—

- (1) Pig-iron.
- (2) American Cotton.
- (3) Greasy Wool.
- (4) Cross-bred Wool.
- (5) Jute.
- (6) English Hides.

The monthly price of each article is expressed as an index based upon that of 1913 as 100, and the changes in these indices from

month to month have been correlated. The factor taken to express the general price-level in this instance has been the Board of Trade Index for "All Articles," as before, and the correlations between the monthly values of this Index and the monthly changes for the individual articles referred to have also been ascertained. In addition, the movements in price for each commodity have been correlated with the corresponding *movements* in the Board of Trade Index for "All Articles." These correlations were in the first place worked out through an oversight, as they were not directly required. They are, however, of a certain interest, and reference to them is made later.

The data covered the same period as before. The average values and standard deviations for the different cases examined were as follows :—

	Index for January, 1922	Average Value of Change in Index from One Month to Next	Standard Deviation of Change in Index from One Month to Next
Pig-iron	130	— .46	5.48
American Cotton	134	.48	18.33
Merino Wool	173	.18	11.82
Cross-bred Wool	70	1.20	12.20
Jute	79	1.36	11.97
English Hides	104	.14	6.24
Board of Trade Index for "All Articles"	164	— .38	3.46

It happens that most of the commodities selected for investigation rose, in two cases very substantially, in price on the average during the period, while the general level of prices was falling. There were, moreover, considerable fluctuations in these individual prices, particularly in the case of American Cotton.

The correlations determined in this case are as follows :—

Correlations between the movement in the price index from one month to the next in the case of the indices for—

	(a) Pig- iron.	(b) Ameri- can Cotton.	(c) Merino Wool.	(d) Cross- bred Wool.	(e) Jute.	(f) English Hides.	(g) Board of Trade General Index of Prices.
Pig-iron		·15	·07	·24	·03	—·10	·28
American Cotton	·15		·05	·05	—·19	·14	·06
Merino Wool	·07	·05		·71	—·00	·27	·50
Cross-bred Wool ..	·24	·05	·71		—·04	—·02	·50
Jute	·03	—·19	—·00	—·04		·06	·24
English Hides	—·10	·14	·27	—·02	—·06		·20
Board of Trade General Index of Prices	·28	·06	·50	·50	·24	·20	

Apart from the correlations between the movements in price of the two varieties of wool, most of these correlations are of small significance, except some of those in which the movement of the Board of Trade General Index is involved. The movements in wool prices, in particular, in the period under review seem to be moderately associated with the corresponding movements of the General Index-number, though it is difficult to see any reason, other than that of accident, for this. The correlations between the actual value of the Board of Trade General Index-number and the corresponding movements in the other indices are as follows :—

Correlations between the Board of Trade General Index-number of one month, and the movement of the price index for individual articles from that month to the next in the case of—

Pig-iron	— ·15
American Cotton	— ·16
Merino Wool	— ·22
Cross-bred Wool	·00
Jute	+ ·23
English Hides	+ ·04
Board of Trade General Index	+ ·06

We can proceed as before to correct for a "constant general level of prices." It is clear, however, from the smallness of the correlations just stated, that no appreciable alteration would be made by the adjustment, and, for practical purposes, the correlations previously stated may be taken as those which would hold when corrected for "constant general level of prices."

These correlations afford less evidence of the influence of common factors affecting the movements in the prices of different commodities than did those set out above relating to the groups of commodities. Whether the correlations previously noted arise in some way owing to the fact that various commodities were included as a group it is difficult to say, though I see no reason why it should. The case of individual commodities is certainly of more interest to those concerned in business, and so far as the evidence relating to the individual commodities goes—and it is recognized that it is far from being exhaustive—it does not afford much support to the view that monetary factors are highly important in determining changes in prices of individual commodities.

It is of interest to compare the results so far reached with corresponding correlations derived from American data. My early impressions were that the influence of monetary factors on the course of prices and industrial activity was likely to be more marked in the United States than in this country. In a diagram first drawn early in 1925, an association between movements in hide prices in the United States and the activity of the Federal Reserve Bank there in buying bills on the open market appeared to be indicated. Diagram II shows :—

- (a) Weekly prices of Chicago Packer Hides.
- (b) Bills bought on Open Market by United States Federal Reserve Bank as at date stated.
- (c) Wholesale price Index of United States Department of Labour.

It will be noted that the general accordance of curve (b) with (a) is quite marked, and shows more association than does curve (c) with (a). The points of resemblance in the two curves can be indicated as follows :—

Inactive Periods of Bill Buying.

- (1) Jan.-April, 1922 ... Hides fell, Jan.-April, from 16c. to 12½c.
- (3) Nov., 1922-Feb., 1923 ... Hides fell, Nov.-Feb., from 21c. to 17½c.
- (5) May-Sept., 1923 ... Hides fell, April-Nov., from 18c. to 11c.
- (7) Jan.-Aug., 1924 ... Hides fell, Feb.-June, from 15½c. to 11½c.
- (9) Dec., 1924-Aug., 1925 ... Hides fell, Dec.-July, from 17c. to 14c.

Active Periods of Bill Buying.

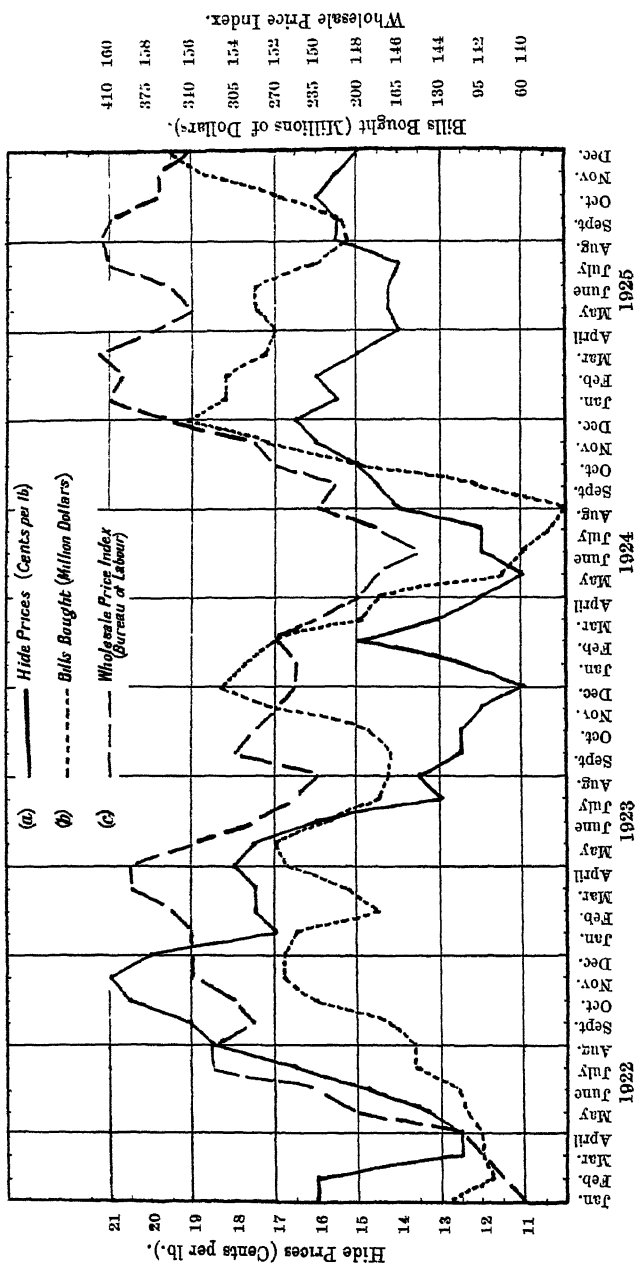
- (2) May-Nov., 1922 ... Hides rose, April-Nov., from 12½c. to 21c.
- (4) Feb.-May, 1923 ... Hides rose, Feb.-April, from 17½c. to 18½c.
- (6) Sept., 1923-Jan., 1924 ... Hides rose, Nov.-Feb., from 11c. to 15½c.
- (8) Aug., 1924-Dec., 1924 ... Hides rose, July-Nov., from 12c. to 17c.

Big buyers of hides, both in the United States and elsewhere disclaim any knowledge of the influence of banking policy on their purchases, and consider the apparent association merely a coincidence. They have for years been too full of other troubles to be in a position to take advantage of easy monetary conditions, other factors being much more weighty in determining when they should make their purchases. On general grounds, however, there is reason to think that the influence of monetary factors in movements of prices would be more apparent in the United States than in other countries.

The first American data examined from this standpoint were the wholesale price index-numbers of the *United States Department of Labor Statistics*, as reclassified by the *Federal Reserve Board* into the groupings (a) Raw Products (88 quotations), (b) Producers' Goods (117 quotations), and (c) Consumers' Goods (199 quotations). The monthly changes in the indices for each of the three groups, beginning from January, 1922, were examined in the same way as the British data previously referred to.

The value in January, 1922 (average value of 1913 taken as 100),

DIAGRAM II.—SHOWING RELATIONSHIP BETWEEN BILLS BOUGHT ON OPEN MARKET BY U.S. FEDERAL RESERVE BANK, HIDE PRICES, AND WHOLESALE PRICE INDEX.



the average monthly movements up to the end of 1925, and the standard deviations of these movements, were as follows :—

	Index, January, 1922.	Average Monthly Movement.	Standard Deviation of Monthly Movement.
Raw Products	139	+·55	3·83
Producers' Goods	123	+·47	2·57
Consumers' Goods	146	+·51	1·98
All Commodities	138	+·36	2·16

Prices in each of the groups were rising on the average throughout the period, and by an amount curiously similar to the decrease noted above in the case of nearly all the Board of Trade groups. The correlations found were as follows :—

*Correlations between the movements from one month to the next
in the case of the price indices for—*

	Raw Products.	Pro- ducers' Goods.	Con- sumers' Goods.	All Commo- dities.
Raw Products		·21	·43	·89
Producers' Goods	·21		·11	·38
Consumers' Goods	·43	·11		·61
All Commodities	·89	·38	·61	

Each group is, of course, substantially correlated with the "All Commodities" group, since each article is a substantial part of the total. The "Raw Products" group, which is, in number of quotations, the smallest proportion of the total, is the most highly correlated with it.

The factor taken to represent the general level of prices in this case was the index-number for "All Commodities." Although each group exercises an appreciable influence on the index-number of "All Commodities," the *monthly changes* in the group indices do not have any similar influence, and correction for "constant index-number for 'All Commodities'" appears therefore to be a satisfactory way of making allowance for the change in the general level of prices over the period.

The average of the indices for "All Commodities" throughout the period was 153.1 and the standard deviation 5.40, the correlations between this index and the movements in the others being as follows:—

Correlations between the index-number for "All Commodities" for any month, and movements in the corresponding group indices from that month to the next in the case of—

(a) Raw Products	— .40
(b) Producers' Goods	+ .07
(c) Consumers' Goods	— .38
(d) All Commodities	— .40

It will be found that the effect of the adjustment is to increase the correlation between "Raw Products" and "Producers' Goods" from .21 to .26, and to reduce the correlation between "Raw Products" and "Consumers' Goods" from .43 to .36. There is accordingly evidence of some, but not very substantial, influence common to all the groups, causing the movements in the price indices for the groups to have a slight similarity. On the whole the correlations between the price indices for groups of commodities in the case of the American data resemble those in the case of the British data.

The commodities, the prices of which were chosen for individual consideration in the case of the American data, were:—

- (a) Pig-iron (Foundry No. 2, Northern (Pittsburgh)),
- (b) Cotton (Middling Upland, New York),
- (c) Wool (Boston) Territory fine staple scoured),
- (d) Hides (Green Salted, packers' heavy native steers (Chicago)),
- (e) Copper (Electrolytic, New York),

and the treatment was the same as in the case of the British data.

The value of the indices in January, 1922 (average of monthly prices in 1913 taken as 100), the average of the monthly movements throughout the period under review (1922-5), and the standard deviations of those movements, were as follows:—

	January, 1921.	Average of Monthly Movements.	Standard Deviation of Monthly Movements.
(a) Pig-iron	133	+ .13	11.0
(b) Cotton	140	+ .40	13.8
(c) Wool	170	+1.24	11.2
(d) Hides	90	— .11	6.5
(e) Copper	86	+ .11	3.4

The price at the beginning of 1922 of 2 of the 5 commodities was appreciably below that of 1913, and remained below the level for the greater part of the period considered

The correlations between the corresponding monthly movements were as follows :—

Correlations between the movements from one month to the next in the case of the price indices for—

	Pig-iron	Cotton	Wool	Hides	Copper
Pig-iron .		·00	·25	·33	·29
Cotton	·00		·11	·04	·02
Wool	·25	·11		·26	·30
Hides .	·33	·04	26		·17
Copper	·29	·02	·30	·17	

The average of these correlations is rather higher than in the case of the British data for individual commodities. None of the correlations, however, is very substantial, though on the whole they indicate the existence of a relatively small influence affecting the movements in price of the articles, except cotton.

In this case the general level of prices was rising throughout the period, the index for "All Commodities" in January, 1922, being 138, and the average increase of the monthly movements ·36. The correlations required for the purpose of correcting for "constant level of prices" were the following :—

Correlations between the price index for "All Commodities" in a particular month, and the movements in the price index of individual commodities between that month and the next in the case of—

(a) Pig-iron...	...	...	—	·03
(b) Cotton ...	...	...	—	·10
(c) Wool ...	...	...	—	·39
(d) Hides ...	...	...	—	·13
(e) Copper ...	...	...	+	·06

Although we are dealing with a period in which the general level of prices was changing at an appreciable rate, the adjustments necessary to allow for this are clearly, from the smallness of these coefficients, quite small. As was the case with the British data, the crude correlations given above represent, approximately, the degree of association when allowance is made for change in price-level. We infer, as before, that the effect of common factors, such as monetary circumstances, in the United States in producing similar movements in prices for different commodities is not very marked.

Many statistical data are available relating to the state of activity of the various industries in the United States, and these data could be handled in the same way as the price data, with a view to ascertaining if there is any influence common to the various industries causing them to increase or decrease in activity simultaneously. For purposes of illustration, and with no idea of dealing fully with the data available nor any illusion regarding their perfection, the indices (referring in each case to the average monthly figure for 1913 as 100) for the following have been worked upon:—

- (a) Pig-iron Production.
- (b) Pig-iron Furnaces in blast at end of month.
- (c) Woollen Spindles active, percentage of total.
- (d) Worsted Spindles active, percentage of total.
- (e) Cotton Consumption.
- (f) Cotton Spindles active, percentage of total.

These indices are published in the February and August numbers of the monthly *Survey of Current Business* issued by the *United States Department of Commerce*. The movements in the indices from month to month from January, 1922, were dealt with just as in the other cases above.

The values of the indices in January, 1922, the average of the monthly movements subsequently up to the end of 1925, and the standard deviations of the movements, were as follows:—

	Value of Index, January, 1922.	Average of Monthly Movements.	Standard Deviation of Monthly Movements.
(a) Pig-iron Production ...	64	1.34	11.3
(b) Pig-iron Furnaces ..	47	.81	7.1
(c) Woollen Spindles .	95	.08	4.7
(d) Worsted Spindles	116	— .43	8.1
(e) Cotton Consumption .	113	.23	11.3
(f) Cotton Spindles	113	— .11	2.0

In the case of Pig-iron and of Cotton alternative indices of activity are available. In each case the rate of increase of material consumed or produced was more than the corresponding rate of increase in the machinery activity, while the variability of the machinery activity from month to month was much less than the variability of the material used or produced. The machinery index is probably not so good as the material index, inasmuch as it relates to the proportion active to the total. Thus, new furnaces or new spindles might be brought into use while old ones remain unused, and the proportion of active ones to total, therefore, would not properly reflect the increase in the number at work.

The correlations between the monthly movements of each index are set out below, together with the correlations between these movements and the price index for "All Commodities." These latter correlations enable us to correct the former correlations for "constant price-level," a necessary adjustment, theoretically, since industrial activity is associated with inflation and deflation.

Correlations between monthly movements of the indices of industrial activity.

	(a) Pig- iron Pro- duction.	(b) Pig- iron Fur- naces.	(c) Woollen Spin- dles.	(d) Worsted Spin- dles.	(e) Cotton Con- sump- tion.	(f) Cotton Spindles.
(a) Pig-iron Production . . .		.73	.42	.34	.45	.41
(b) Pig-iron Furnaces . . .	.73		.49	.39	.28	.49
(c) Woollen Spindles . . .	.42	.49		.49	.34	.29
(d) Worsted Spindles . . .	.34	.39	.49		.39	.72
(e) Cotton Consumption . . .	.45	.28	.34	.39		.44
(f) Cotton Spindles . . .	.41	.49	.29	.72	.44	

Correlations between the value of the price index for "All Commodities" in any month, with the movement in the index of activity between that month and the next in the case of—

(a) Pig-iron Production	...	...	·04
(b) Pig-iron Furnaces	...	...	·05
(c) Woollen Spindles	...	...	— ·18
(d) Worsted Spindles	...	...	·19
(e) Cotton Consumption	...	...	·14
(f) Cotton Spindles	...	...	·38

In every case, the correlation between monthly movements in the various indices of activity is appreciable. The substantial correlation ($\cdot73$) between movements in the indices for Pig-iron "Production" and "Furnaces active" would be expected, and it is perhaps surprising that the correlation between movements in the indices for Cotton "Consumption" and "Spindles active" is no higher than $\cdot44$. The highest correlation between movements of independent indices is that in the case of "Worsted Spindles" and "Cotton Spindles" ($\cdot72$). The other independent correlations range round about $\cdot40$.

The smallness of the correlations between the price index and the movements of the other indices shows that, except in one case, the adjustment of the crude correlations for "constant price-level" is a small one. The exception is in the correlation between movements in the index for "Woollen Spindles" and in that for "Cotton Spindles." The crude correlation of $\cdot29$ when adjusted for the change in the price-level becomes $\cdot39$.

When allowance is made for the general change in the level of prices occurring throughout the four years under review (the index-number for "All Commodities" rose from 138 in January, 1922, to 160 in July-September, 1925), it would appear that there was a fair amount of association ($\cdot4$) between synchronous movements in activity in the Iron, Woollen and Cotton industries, this being due to some general causes influencing the industries named. We are not justified, however, in assuming that monetary movements alone produced this influence, as there might have been other general causes operating. For example, during the period stated there was a very large amount of "re-housing" going on in the States, this causing a general boom in the Building trade, and it might be that this exercised an influence over the activity of many other industries and helped in creating the correlations mentioned.

A few correlations were determined with reference to movements

in industrial activity in different industries working upon the original data expressing that activity, and not upon the index-numbers. Although we have necessarily worked hitherto with index-numbers, it does not seem to be essential to do so on this part of the problem, and we can compare the increase from one month to the next in Pig-iron "Production" in tons with, say, the corresponding movement in the "consumption" of wool in thousands of pounds, just as well as we could make the comparison by index-numbers. The industries selected for consideration by these means were :—

- (a) Pig-iron, for which the production in thousands of tons was the unit used ;
- (b) Wool, for which the consumption (in grease equivalent) in thousands of pounds was the unit used ; and
- (c) Cotton, for which the consumption in thousands of bales was the unit.

Using the data for the same period as before—monthly figures from January, 1922, to December, 1925—the values of the units in January, 1922, the average value of the monthly changes, and the standard deviations of the monthly changes were as follows :—

[In thousands.]

	Value. January, 1922.	Average Value of Monthly Changes.	Standard Deviation of Monthly Changes.
Pig-iron Production . tons	1,645	£ + 32	289
Wool Consumption lbs.	52,280	+ 150	5,650
Cotton Consumption bales	527	+ 1.1	54.6

In addition to ascertaining the correlation between the monthly changes in the case of each of the three items, the correlations between each of these and the corresponding monthly movements in the price index for "All Commodities" were calculated. These gave an indication of the extent to which movements in activity in particular industries are associated with movements in general prices. The correlations found were the following :—

Correlations between monthly changes in (a) Pig-iron Production, (b) Wool Consumption, (c) Cotton Consumption, and (d) Price Index for "All Commodities."

	Pig-iron Pro- duction.	Wool Con- sump- tion	Cotton Con- sump- tion.	Price Index.
Pig-iron Production		·37	·59	·24
Wool Consumption	·37		·84	·28
Cotton Consumption	·59	·84		·12
Price Index	·24	·28	·12	

These correlations indicate fairly substantial association between the monthly movements in the Iron, Cotton and Wool industries, in particular between the Wool and Cotton industry. In dealing above with the indices of production, viz., proportion of "Worsted spindles" in operation and proportion of "Cotton spindles" in operation, we also found a high correlation (·72), though the coefficient of "Woollen spindles" and "Cotton spindles" was much smaller (·29).

These coefficients confirm the previous results, indicating a moderate degree of association in the simultaneous movements in the industries. The correlations between these separate movements and the corresponding movements in the wholesale price index, however, are smaller, and do not indicate that movements in industrial activity are closely associated with movements in the general price-level.

For the purpose of adjusting the correlations to allow for changing price-level, the correlations between the monthly movements in (a) (b) and (c) and the actual value of the price index for "All Commodities" were worked out. They were as follows:—

Correlation between the price index for "All Commodities" in one month, and the movement from that month to the next in (a) Pig-iron Production, (b) Wool Consumption, and (c) Cotton Consumption:—

(a) Pig-iron Production	...	...	·10
(b) Wool Consumption	...	...	— ·05
(c) Cotton Consumption	...	...	·12

As in most of the other cases referred to previously, these correlations are too small to cause any significant adjustment to the crude correlations.

We conclude that the facts of the last four years are not inconsistent with the theory that the monetary lubricant does influence changes in the state of industrial activity, though the influence does not appear to be very substantial and the changes are not produced through corresponding changes in prices. There appears to be little association between industrial activity and commodity price changes, and again between price changes and monetary freedom or stringency. Evidence probably exists that an upward movement in prices of Stock Exchange securities induces buying, but so far as commodity prices are concerned, this principle, though assumed as axiomatic in some quarters, does not appear to be of wide applicability, under the conditions in this country of the last four years.

Manufacturers in some industries at any rate are now convinced of the correctness of the policy of letting the conditions of the market of the article they manufacture control the price they will pay for their raw material. If there is an upper limit to the price at which they can sell the product, they will only buy their raw material so long as the price enables them to avoid a loss. If this cannot be done, they reduce the rate of production. The fact that, through the peculiar circumstances of the Russian market for Leather, for example, tanners in that country could pay higher prices for hides in the world's markets than could tanners in the United States and this country, resulted in the latter refraining from operating in the market until hide prices receded.

As mentioned earlier, my purpose in writing this paper was to suggest (and to bring some evidence supporting the suggestion) that the influence of short-period changes in monetary circumstances in producing variations in prices has been exaggerated, and to put forward the view that the specific circumstances associated with the individual commodities are more important than the monetary factors. Although this analysis does little more than scratch the surface of the mass of data now available on the subject, it does indicate that more definite analysis should be made by those who accept the view that periods of "easy" money and "tight" money conditions are the main factors in determining variations in prices of individual commodities, and that these necessarily outweigh the specific factors.

Judged by the confidence of those making the forecasts, it appears to be very much more simple to prophesy the movements of the general level of prices of all commodities than it is the movements

of the price of an individual article. Whether it really is of great practical value to be able to forecast the movements of the General Index is a matter of opinion, but it obviously is much less important than it would be if the course of the movements of the General Index provided any criteria of individual movements.

Those concerned with the price movements of individual raw materials seem much less confident in their predictions, however familiar they may be with the specific factors associated with the commodity, than those forecasting the average movements in prices. It is nevertheless quite a fascinating occupation to attempt regular forecasts of the movements in price of an individual material, such as Cotton, Wool, or Hides.

Apart from monetary considerations and the factors associated with the production and consumption of the commodity, the forecaster has to contend with other factors, to which the word "speculative" is often applied. "Speculation" is to some extent a matter of definition, and is certainly a matter of degree.

At one end of the scale is the manufacturer who buys raw material only sufficient for his actual needs to execute orders he has actually received or has substantial reason to expect he will have. Next there is the manufacturer, who, if he thinks the market is likely to rise in the near future, will buy in excess of his immediate requirements, anticipating future orders, in the expectation that he will in this way obtain his raw materials cheaper than would be the case if he waited until he received further orders for his product. If the material is the result of a seasonal crop, there is much to be said from the producers' point of view in favour of the manufacturer buying in advance of his requirements. The producer cannot be expected to finance the holding of it pending the manufacturer requiring it; and it is better for the material to be sold to the actual consumer than that it should be financed by a bank or a middle-man, as it provides the definite knowledge that it has been taken up for consumption and will not be resold later in competition with other material from the seller. So long as it is financed by a bank or held by a middle-man there is an element of uncertainty.

Next, there is the merchant regularly concerned with the buying and selling of the raw material in question, who buys heavily when he feels that the circumstances warrant it in the expectation of reselling to a consumer or another merchant at a higher price. The great difference between this case and the previous one, from the point of view of its effect on prices, is that the merchant *has* to resell, in every case, even at a loss if his judgment turns out to be wrong. The manufacturer, however, does not require to resell whatever the

movement in the price. The effect of the manufacturer's buying in anticipation is probably to steady the course of prices and to reduce fluctuations within narrower limits than would otherwise be the case. It is by no means certain, however, that the same effect is produced by the buying of merchants. It is probable that the pressure to sell, whatever the circumstances, is much stronger than the eagerness to buy, and this causes the fall in price to be more rapid than the corresponding rise. When buying, the merchant is influenced almost entirely by his own judgment of what to do and when to do it, but considerations of finance enter into the question of selling, and frequently it happens that the merchant is compelled to sell through financial pressure when his own judgment would lead him to wait.

These three stages occur in the case probably of nearly all raw materials, and there is no clear line of demarcation between them. The further stage in the line of speculation occurs only with certain commodities, *e.g.* non-ferrous metals, others being entirely free from it. This occurs when outsiders, not associated as a rule with the industry, take an occasional hand in the market, because they have the impression that there is a profit to be made. Frequently they never intend to hold the material, and actually only deal in a document giving them the right to the material. They may buy the document with the intention to sell it before they are required to take physical possession of the goods, or they may sell the certificate before they possess it, in the expectation of being able to buy it cheaper before the moment arrives to hand it over to the person they have contracted to deliver it to. No definition of "speculation" would exclude this last class of transaction, which, in commerce, is kept as a rule within bounds by reason of the fact that amateur operators are at a disadvantage in knowledge and judgment in competing with the professionals regularly in the trade.

These factors introduce complications into the problem of price prediction which in the case of certain articles and over short periods are occasionally more potent than any of the causes previously enunciated. This very largely accounts for the great difficulty in accurately forecasting short-period movements of prices in, for example, such commodities as tin and other non-ferrous metals. It is not so difficult to foresee probable monetary policy, and the statistics of consumption and of production are fairly reliable, but it is impossible to foretell what views and actions other people operating in the market are going to take. There may appear to be neither rhyme nor reason for these actions, but they may cause all carefully estimated calculations to be upset. The process called "taking a

view" (which not infrequently might be more appropriately called "taking a leap in the dark") is not an uncommon one in some branches of commerce. In some instances market operations resolve themselves into a contest between two parties, each of whom has "taken a view" of the market, but a different one. There is no more reason, perhaps, for the view of the "bulls" than for that of the "bears," but one of them has to prevail, just as one horse has to win in every race.

The point is, however, that these factors, though apparently irrational, exercise an influence which frequently completely defeats the efforts of those working on rational methods, who assess in a scientific manner the proper weight to be given to the concrete factors. For the same reason it not infrequently happens that those incapable of judging the proper value of the concrete factors are found to be correct in their forecasts. There is probably no economic problem, certainly no business problem, for which complete data are available, and it is well to remind those trained to weigh scientifically the evident factors in the problem of the existence of the fortuitous ones. The existence of these renders it impossible that business forecasting can ever become, even approximately, an exact science. The business man in this country has not shown that he is greatly impressed by the results of all the work which has been done for his guidance. In the United States there was a period in which the forecasting profession was held in esteem by the business man, but this would appear to be passing, mainly owing to the extravagance of the prophets. It would be a real misfortune if the reaction from this period of profuse prognostications led to the discredit of this class of economic inquiry. May it therefore be suggested that there should be a close season in which business forecasts should not be published but in which the prophets should scrutinize their past prophecies in the light of subsequent events? This plea would appear to be supported by a prominent American writer on the subject who, in a recent book collecting the conclusions of more than twenty of the forecasting experts in that country, states "there is often a radical difference of opinion among some of our leading forecasters, . . . Some of the organizations that statisticians think are using questionable methods were nearer right than other organizations that are supposed to be using the most scientific methods."

The results which would probably follow the hard thinking of such a period of restraint would help to establish definitely the status of the business forecaster, and would free him from unfortunate comparisons with those who pretend to prophesy the results of more popular events in the daily press.

DISCUSSION ON DR. SNOW'S PAPER.

MR. N. CRUMP: It gives me very great pleasure to propose a vote of thanks to Dr. Snow for his paper. First of all, because Dr. Snow and I have both been working in the same field for many years. It is a very interesting field, and one which, as I think we can both agree, has only so far been very incompletely explored. Secondly, because if in days to come we feel we do know something about this field, I think all will agree that one of the factors that helped us was the series of papers which Dr. Snow has presented to this Society from time to time, and of which this is the latest example. Finally I have to thank Dr. Snow for putting me on the horns of dilemma. For many years after the war I was associated with the Federation of British Industries. I was for some time assistant secretary to Dr. Leaf, and when I find Dr. Snow setting one authority up against the other. I rather wonder exactly what position I ought to take.

I am sure Dr. Snow will forgive me if I go directly to the points on which I differ from him, and that he will not think I am slurring over the many points with which I am in agreement.

I would refer first of all to p. 639 of Dr. Snow's paper, where he speaks of the banker being in the position of holding the lubricating can. Now, as I understand, the banker's position is this: He comes down to his office on a given morning and looks at his accounts and sees that he has *x* gallons of oil at his disposal and no more, and hence that that is the limit of his lubricating capacity. That is the first point he has to bear in mind. The second point is—and here I part company from Dr. Snow—that it is part of the banker's business to know how, where, and when he should use his oil. He must not only take into account the borrower's capacity, but, unlike the man in a power-station who goes round with his oil-can and does not expect to get his oil back again, the banker does expect to get his oil back again, and that before very long. Therefore, he has to take into account not only the standing of the particular customer applying for a loan, but he also has to take into account the state of trade and of the particular industry in which that customer is engaged, and if he thinks production in that trade has been carried to an excessive extent, he has to use his discretion as to whether or not to make a loan.

I know of some occasions in which bankers have lent one sum of money and have then had to lend a second amount in order to get the first back. But those cases are not frequent. In general, I think we must all admit that the banker, in using his oil-can, must take into account the efficiency of the particular bearing into which he proposes to inject the oil.

The real question raised by Dr. Snow is not where the banker is to put his oil, but whether the banker, the Treasury, or anybody else, ought to have the power to manufacture more oil. That is the real crux. At present, if the banker runs out of oil, he can only buy

it: he cannot sit down and grind a handle to make more oil. It comes down to this: if we admit the principle of the manufacture of fresh money—who is to have the right to manufacture it? Those of us who support the gold standard deny that right: and in our support we can point to the awful examples we have had on the Continent during the past few years.

I now come to the foot of p. 641, where Dr. Snow says: "Yet, when the 'price relatives' for all these individual commodities are combined to form a single index to represent the average experience of them all, it is assumed that variations in this index are due to monetary considerations. If these considerations are secondary in the individual price movements, it is not justifiable to assume that they are of primary importance in the movements of the general wholesale price movements." Here again I am sure Dr. Snow will forgive me if I part company a little from him. I have been working on price index-numbers for five years now, and if I know at all what I was doing, it was this. You take the price of any particular commodity and you turn over in your own mind what made up that price. And the conclusion come to is that there are two factors at work—one general, the other peculiar.

Now Dr. Snow has given his own explanation at the bottom of p. 645:—

- “(1) The factors affecting the general value of money.
- “(2) The factors affecting the 'Short period' use of money.
- “(3) The factors specifically associated with the particular article, *e.g.* variations in crops.”

I am a little inclined to merge the first two together and contrast them with the third, and you then get down to the monetary factor common to all commodities, and the supply or demand for any particular commodity, this being the second or peculiar factor. Therefore, when you come to make your index-number, what I suggest you are really doing is to eliminate all those peculiar factors such as the state of the cotton crop, etc., and to leave behind a general common residuum—the monetary factor—the incidence of which is reflected by changes in the general price-level. This may be going rather far, and I do not know that everybody will be disposed to agree with me, but if that is a fair explanation I suggest that you can really get an answer to Dr. Snow's main question in the following way:—If the general price-level rises 5 per cent. between one month and the next, and the price of cotton during the same period goes up by 10 per cent., is it not fair to say that 5 per cent. of the rise is due to the general factor and the remainder due to the particular factor—for example, a shortage of cotton? If so—and I am open to be convinced on this point—instead of it being necessary to calculate these correlations, what has to be done is to examine any given month or year, considering both the general index and also the individual price relatives. If the price of every single item has gone down or up by 5 per cent., this shows that the peculiar factors were not operating. If, on the contrary, the price-level remains

practically unchanged while individual items show wide variations, you say that the monetary factor is not operating.

I made a brief examination of my own figures, and the rough conclusion I came to myself in the space of five minutes was that, whereas in 1922, 1923 and 1924, and up to last May, the third factor was pre-eminent and the monetary factor remained in the background, I am not at all certain that during the last year—May, 1925, to May, 1926—the monetary factor did not emerge.

In any case, I am sure Dr. Snow would agree with me that the correlation of indices is rather a dangerous amusement. I well remember that when last December I was in Mr. Coates's office in Ottawa and came across a proof of the Chairman's paper on "Nonsense Correlations," how glad I was to read it, and how much it cheered me up. As I have said, correlation coefficients can be a very dangerous weapon, liable to hurt the user as much as the person they are aimed at. For example, Dr. Snow has drawn attention to the correlations between movements in different groups, especially that between the Board of Trade group index for "Iron and Steel" and for "Other Metals and Minerals," and he pointed out that this is much greater than any other correlation. With due diffidence, I venture to point out that "Other Metals and Minerals" is half made up of coal, and the pre-eminent factor in the price of iron and steel is the price of coal. So much is this so that five years ago Mr. Flux said that he purposely allowed coal an insufficient weight, because coal was virtually repeated in the iron and steel group. To check this point, I have made a rough correlation for 1923 between the steel group and the fuel group in my own index-number, and I got a correlation coefficient not of 0.66, but of 0.84, which I think is sufficiently high to come within Mr. Yule's category of "Nonsense Correlations."

Again, the whole question of the proper segregation of group indices is extraordinarily difficult— one is always running up against border-line commodities. I remember having a long conversation with Mr. Flux several years ago on the question of splitting the Board of Trade "Other Metals and Minerals" group, and the question came up as to what was to be done with lubricating oil: should it come under "Other Metals" or "Fuel"? I forget how the point was settled, but I know we got on to the growth of aviation. Now aeroplanes, as we pointed out, use as their lubricant castor oil. Was this an "Other Metal" or "Fuel," or a "Miscellaneous Material"? The only thing we were agreed upon was that it should not be placed under "Miscellaneous Foods." I quote this merely to show that the whole question of making up group indices is extraordinarily delicate. What is one to do with items like eggs, or potatoes, or even rubber?

I now come to the American section of this paper, and I should like to throw out one or two points for Dr. Snow's consideration. One is the improvement during the last few years in transport facilities. Owing to this great improvement on the American

railroads, manufacturers and merchants have come to the conclusion that they can work on quite small stocks, because of the certainty of being able to replenish their stocks at short notice. And this means that, compared with a few years ago, they need much less assistance from their bankers in proportion to their turn-over; in other words, the same volume of trade now needs less money. The other point I should like to put forward in this connection is another new development which has assumed very wide dimensions in the States of recent years, and which we are beginning to see over here. I do not know the best way to describe it, but I think I will use the description given last November by Colonel Ayres: "A dollar down and a dollar a week." The reactions of instalment buying on the flow of money and trade are now being very seriously discussed in America. Through the growth of the instalment system, the consumer buys the goods before he can pay for them, and if this is so, how does this modify the interpretation of the American statistics included in the paper? You can walk down any street in New York and see everything exposed for sale on the dollar down and dollar a week principle. Many bankers are getting extremely nervous about the rapid growth of this practice.

Dr. Snow has covered a very wide amount of ground, and I have only been able to allude to one or two points. I hope he will not think I have been unduly critical. I have not had time to go into the many points on which I find myself in agreement, and I wish to assure him how well I know the amount of tedious work and the amount of knowledge he has put into this paper. I am sure all will agree with me in according a hearty vote of thanks to Dr. Snow for his excellent paper.

Mr. R. G. HAWTREY: I have much pleasure in seconding the vote of thanks for this ingenious and, I think, also laborious paper.

In criticizing it, the first observation I am led to make is with regard to exactly what it is that Dr. Snow is attacking. Towards the end of his paper he refers to people who "accept the view that periods of easy and tight money conditions are the main factors in determining the variations in the prices of individual commodities." That is not what the Federation of British Industries said in the quotation he gave at the beginning, nor, so far as I know, is it the view of anybody with whose work I am acquainted.

The main burden of the paper was to prove that the movements affecting individual commodities were more important than the movements affecting prices as a whole. That may be so. But it does not in the least prove that the monetary factor, or any other factor affecting markets as a whole, is *unimportant*. It may be less important to the dealer in hides than movements affecting finished leather, but it does not follow that it is *unimportant* in itself, or that the work done by the business forecasters is not extremely valuable.

It is probably quite true that, in any given commodity, in the

majority of cases there are factors affecting that commodity which produce much bigger variations over short periods—and possibly over long periods, too—than the monetary factor. I do not think the periods chosen by Dr. Snow were very well calculated to prove or disprove that. His original quotation from the Federation of British Industries refers to the pre-war trade cycle, the *major pre-war international fluctuations*: he confines himself to *minor post-war national fluctuations*. The particular period of years he took in England was a period when the monetary factor showed remarkably little fluctuation. It was the period 1922–6, when trade was suffering from an almost unrelieved depression, and monetary changes in prices were probably on the whole not very great—at any rate, over short periods. I should describe what happened as a gentle pressure exercised upon credit throughout the period, except over one short interval at the end of 1923 and the beginning of 1924. Under these conditions it was extremely unlikely that analysis would reveal any monetary effect that was at all large. In the United States there was a good deal more fluctuation, but there, throughout the whole time, there was a consistent effort to stabilize business.

In order to get a fair test of Dr. Snow's thesis, he ought to have applied it to a pre-war period, when he would get the monetary factor in full operation in an international system, and when it was possible to bring in, not only the quiet intermediate interval, but also the turning-points in periods of the trade cycle.

Then he might possibly have found that the monetary factor was more important than these calculations show. On the other hand, I do not think he would have found that the monetary factor made itself felt in very short periods. It usually moved gradually, and therefore I think he is probably right in contending that to the individual dealer in a commodity the monetary factor is in most cases of little importance. But in the particular case of the heavy industries the monetary factor is of extreme importance.

There is an observation to which I should like to call attention, at the end of the last paragraph on p. 662. Dr. Snow refers to the synchronizing of certain movements in industries, and suggests that "during the period stated there was a large amount of 're-housing' going on in the States, this causing a general boom in the building trade, and it might be that this exercised an influence over the activity of many other industries and helped in creating the correlations mentioned."

One of the fundamental principles in the monetary theory of the trade cycle is this, that if the monetary supply is so regulated that the total money income of the country is kept steady over any period, then an increase of demand in any group of industries can only be at the expense of a decrease of demand in the others. Therefore there cannot be a sympathetic spread of prosperity from one industry to another unless the monetary supply is so regulated that there can be an *increase in total demand*. If an expansion of credit is allowed to take place, then no doubt you may get the contagion of activity

spreading from one industry to another. That passage seems to me to show that Dr. Snow has been rather missing the main point in the monetary theory. If you look at a number of other quotations, particularly in the early part of his paper (on p. 641), you will see that he deals at some length with the impressions that people in particular industries get of the various influences affecting them, and he always refers to the demand for any particular product as if it were somehow a given thing, not as if it were an outlay of money, the money itself being a product of the credit system. Dr. Snow takes it for granted that, for example, there will be a certain demand for boots, quite independent of the monetary conditions. When he refers to export industries on p. 639, he says "The cotton industry in this country, for instance, for which the proportion of export trade is much larger than for any other important industry, pays more attention to events in India and China—quite unconnected with our monetary policy—than to the ease or stringency of the money market." I would reply that the greater part of the Eastern trade is financed with sterling bills, and that money stringency in London has the effect of depressing buying power in India and China. As a matter of fact, credit pressure in London affects demand all over the world, and tends to produce forced sales of commodities, to discourage purchases of commodities, and to cause a general trade depression. That has been seen in the past twelve months, when there has been a marked depression all over Europe, particularly in the heavy industries, which are especially susceptible to credit conditions. As soon as there is depression, the volume of savings is diminished, and the heavy industries feel the consequences.

There is one other point I would like to mention. Dr. Snow refers to invisible exports on p. 641. I think he has overlooked the existence of invisible imports.* The main reason why this marked change in the proportion of imports covered by invisible exports occurred was that there had been a decrease in invisible imports.

Dr. L. ISSERLIS said he would like to draw attention to one general aspect of the paper, without taking part in a controversy about which he knew nothing—the value of the particular factor which had been criticized by Dr. Snow. While listening to the paper he had had a feeling that in trying to press his particular point Dr. Snow proved a great deal too much. There were undoubted trade cycles and undoubted movements in production as well as in price indices in great groups of commodities which in the long run moved together, and it was the business of the statistician to discover the existence of one or more of a series of common factors. By drawing attention to the importance of the fluctuations in the prices of the individual commodities and asking for concentration on that point, Dr. Snow was asking statisticians to give up the value of statistical method in studying the movements of aggregates as a whole.

* *i.e.* exports of capital.

He did not wish to elaborate that point just now as it would take too long, but in this connection he would like to emphasize the brevity of the period which Dr. Snow had been examining.

He had himself been trying for the last year or two to discover the general trend and possibility of the existence of a factor responsible for that trend in the case of one particular commodity—shipping services—and he had felt that the fact that he had only in his possession material extending over sixty years or so was a handicap, because the period was too short. It might only include five or six sun-spot cycles.

If he might depart from the general aspect of the paper and draw attention to one thing referred to incidentally, to which Dr. Snow attached some importance, he would like to refer to p. 640. For the years 1910, 1913 and 1923-5 figures were given showing the net imports of merchandise and exports, and, for a reason which was a mystery to him, the figures of invisible exports for 1910 and 1913 were omitted, because figures constructed on a similar basis to the last figures were not available. He could not see any meaning in the paragraph on p. 641. which suggested that there had been a change-over, and that imports were being paid for to a larger extent by invisible exports than by visible exports. As one who knew something about an industry that contributed a part of these invisible exports, he would say at once that, so far as shipping was concerned, shipping could be little considered in connection with invisible imports unless cargoes were provided. He had no wish to poach on other people's preserves, but it might be that the bankers and the brokers would feel much in the same way as he did about this matter. It might be said that the bankers would not make profits on banking if there were no commercial projects to finance. The figures for 1923-5 showed a greater dependence on invisible exports for the balancing of this country's trade, and this was not a matter of comfort.

Another point to which he would like to refer was the possibility that, in dealing with what Dr. Snow called the monetary factor, he had perhaps dwelt too exclusively on the British price-level and on British monetary policy. The index-number of wholesale prices could be conveniently divided into two parts, one giving an index-number of the prices of exports and the other that of imports. While the Board of Trade did not break up the index-number as such, it gave separately the level of average prices of exports and imports. Of late years British manufacturers had been asking the foreigner to pay more for British exports than he did before the war; the foreigner had not been able to afford it, and there had been a real difficulty under these conditions in selling British products abroad. Among other things, it had influenced the other item of invisible exports.

Another point in connection with invisible exports was that in the normal condition of affairs the value of British visible exports was more nearly equal to that of imports, and visible exports + invisible

exports together provided a balance available for investment abroad. It was this balance that had been reduced in recent years, and it was possible that there might be a greater correlation between the prosperity of the heavy metal trades and the amount of this balance available for investment abroad than was realized, because, after all, South America and other countries that had in the past built railways of British material with money that was invested by British citizens were now less able to do so.

Mr. H. W. MACROSTY said that the indices of export and import prices, to which Dr. Isserlis referred, were not based on the Board of Trade's index-numbers of wholesale prices, but on the quarterly articles on "Volume and Value of our Overseas Trade" published in the *Board of Trade Journal*.

There was a great deal to be said about Dr. Snow's paper. The relatively high correlation between iron and cotton recalled a problem put before him some twenty-five years ago by a prominent iron-master, who wanted him to examine the connection between the prices of iron, steel and coal on the one side and cotton on the other, because, said he, "those two groups form the commodities with which we buy our imports. If cotton is cheap, the exportation of cotton goods will be fostered, and there will be less need for the export of iron and steel goods, and, therefore, that industry will languish, and ultimately the prices of iron and steel goods will come down in sympathy with the fall in price of cotton goods." It seemed that Dr. Snow's correlation figure supported that theory. The low correlation between cotton and wool was, of course, explained by the fact that the markets were different. The high correlation between merino and cross-bred wool was puzzling, because at one time there was no correlation between merino and cross-bred, prices of merino rising and cross-breds remaining low, but later the scarcity of merino forced up the values of the finer cross-breds. The degree of correlation would depend upon the particular stage in the price movement which was being worked upon. The relatively high correlation between pig-iron made and wool and cotton spindles in operation was due to the fact that the former represented producers' goods and the latter consumers' goods, and as activity of consumption ultimately determined capital development, in the long run the prices of representative consumers' goods and of capital goods would be connected. It was dangerous to use the wool consumption figures for the United States, because the American Wool Company and some score of other companies did not contribute particulars of their consumption to the Department of Commerce.

With the general conclusion of Dr. Snow's paper, that short-term price movements were determined by commodities rather than by money, and long-term movements by changes in money, Mr. Macrosty was in agreement.

It was rather sad that Mr. Hawtrey had complained that Dr. Snow had taken a period of time, 1922-5, which would not prove

the contrary of his thesis, for a historical investigation of the preceding period, 1919-22, showed that monetary factors, though fairly prominent, had had little to do with the price movements of that period. No one would deal with the war period, and it would seem that they were going to be thrown back on the pre-war period, a time during which it was doubtful whether data would be found of sufficient validity for either Dr. Snow or Mr. Hawtrey to prove their case.

Mr. TENNYSON said that the Federation of British Industries, for whom he spoke, had reason to congratulate itself, if only in having promoted the extraordinarily interesting paper of Dr. Snow's and the valuable statement by Mr. Crump.

He did not want to add anything very much to what Mr. Hawtrey had said, but he would like to call attention to the question on p. 636 of Dr. Snow's paper, where he quoted from the statement of the Federation of British Industries, as follows:—"The above must not be taken as implying that the only influence determining trade-cycle movements is money, for there are instances of fairly definite expansions and contractions of trade unaccompanied by any very marked alteration in monetary conditions. There can, however, be no doubt that money was one of the outstanding influences in the major pre-war international fluctuations." He took it that Dr. Snow would not disagree with that statement, and in spite of what the last speaker had said about the difficulty of obtaining a satisfactory pre-war analysis, he could not help thinking that it would have been fairer to the principles on which they had acted if a pre-war basis could have been taken, for since the end of the war conditions had been so abnormal—particularly in regard to supply—that the supply factors might well have been of greater importance relatively than the demand factor. For this reason he thought it would be better if the analysis could be extended back to the pre-war period, thus getting a truer view. Speaking briefly, the view taken was that, in trying to make a forecast of the trade cycle, the demand factors were of the most importance.

He disagreed with what Dr. Snow had said about the desirability of a closed time for forecasters. Surely all would agree that it was of the greatest importance that we should be able to make accurate forecasts if at all possible. The only way to arrive at this was for the forecasters to continue publishing their forecasts and standing to be shot at. In adopting this policy the Federation of British Industries was fulfilling a useful purpose, and they intended to continue it.

Owing to the late hour and the fact that the Annual General Meeting of members had been called to follow the meeting, the CHAIRMAN proposed that Dr. Snow should reply to the discussion in writing.

In thanking the meeting for the vote of thanks, Dr. SNOW said, in reply to the remarks by Mr. Hawtrey and Dr. Isserlis, that

he would like to make it clear that the paper was not intended to be an attack upon anybody. It was merely intended as an attempt to elucidate truth and to provoke a discussion

Dr. Snow subsequently wrote as follows :—

There were three cardinal points raised in the discussion on the main subject of the paper :—

- (1) The interpretation of movements in the index-number of prices.
- (2) The importance of monetary factors in determining movements in industry.
- (3) The practical value of trade forecasting.

On the first point Mr. Crump announces himself as an adherent of the comforting doctrine of the cancelling out of the effect of the individual extraneous factors which influence prices, and accepts the assumption that changes in the price index-number are accordingly due to the common factors, *e.g.* the monetary ones. It is fairly certain, of course, that at no time do all these individual factors operate in the same direction, but I can see no justification for the assumption that the *algebraical* sum of their contribution towards the index-number is necessarily zero. This algebraical sum will sometimes be positive and sometimes be negative, but it will generally have a definite value (*e*). In addition the index-number will be changed by an amount (*u*) due only to the common factors (*e.g.* the monetary factor) affecting all prices. The change in the index-number from one month to the next tells us the value of $e + u$, but throws no light whatever on the relative values of *e* and *u*. The index-number is too crude an implement to do this. It seems to me quite feasible, however, to construct another index-number which will, approximately, do this, and I have for my own purposes used a somewhat imperfect one for some time. The thesis of that part of the paper dealing with this subject is that there is no more theoretical justification for assuming that *e* is zero, and that all the change in the index-number is determined by the common factors, than that *u* is zero and that all the change is determined by the individual factors.

The second point, on the connection between monetary movements and movements in trade and industry, appears to me to involve an extremely difficult problem of separating cause and effect. Cause and effect are mixed up in this problem in the most subtle manner. The view that movements of trade are determined by monetary changes is very common, but there are bankers who hold the converse view, viz. that monetary changes are initiated by trade movements. The fact of the matter seems to be that the trade and industrial machine, as well as the monetary machine, is so complicated that every movement is at the same time both a cause and an effect, and it is impossible to separate them. In periods of marked inflation or deflation the predominant importance of the monetary factor becomes pretty obvious as the cause of trade movements, but under

the circumstances of this country or of the United States at the present time the bankers' view, expressed at the beginning of the paper, seems best to fit the facts.

On the third point, namely, the practical value of trade forecasting, the circumstances of the present time have to be sharply distinguished from those of periods of marked inflation and deflation. During these periods many forecasts were quite accurate, but it did not need much specialized skill to foretell the course of trade under such conditions, and many who did not dignify their views with special technical jargon were equally accurate in foretelling events. But the circumstances of the last two or three years have been different, and I do not think that the specialists are able to point to an appreciably greater measure of success than the amateurs, and the quotation given towards the end of the paper shows that the same view is held in authoritative quarters in the United States. Replying to Mr. Tennyson's point about the publication of the results of the forecasters, I fear the words I used in the paper were rather ambiguous. I certainly think that these results should be available for thorough circulation among those able to judge and criticize both the methods used and the deductions made. I deprecate, however, the wider circulation at present among those not able to appreciate the methods used and therefore in danger of attaching an exaggerated importance to the results announced. There are people who believe that the professional forecasters have by the application of exact scientific methods discovered some immutable truths, and the reaction when it is found that these truths are of very limited application, both in time and space, does a great deal of harm to economic science.

Some of the questions raised by Dr. Isserlis and Mr. Hawtrey were answered for me by Mr. Macrosty in the discussion. Dr. Isserlis, referring to the digression on the relative importance of visible and invisible exports, holds that one part of the invisible exports, viz. remuneration for shipping services, must be subordinate to the visible exports, since the shippers' remuneration will diminish if the amount of goods to be carried diminishes. This is true, but at the same time it may well be that the visible exports have diminished to a greater extent than the remuneration for shipping services. Also, there is reason to believe that remuneration from insurance and reinsurance has increased substantially, while I think that the pecuniary advantages which we now receive through the payments of tourists in this country in comparison with the pre-war period has been underestimated.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society :—

Harry Bergman.
Alfred Basil Blake, B.Sc.
Prof. John Higson Cover.
Mohamed Fahmy Leheta.

Prof. Prasanta Chandra Mahalanobis.
Richard Jamieson Winters,
A.C.R.A.

MISCELLANEA.

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SOME STATISTICS CONCERNING OCCUPATIONAL INVALIDITY—
ECONOMIC, MENTAL AND MORAL.

By D. CARADOG JONES, M.A.

ONE volume of the 1921 Census Tables for England and Wales deals with the Occupations of the people, and one page of that volume shows the numbers of males and females enumerated in Poor Law Institutions, in Homes, etc., for Lunatics, and in Prisons, respectively, grouped according to their occupations, or former occupations.

There are 32 main orders of occupations, if we include the "Retired or Not Gainfully Occupied" as one, and these main orders are subdivided, but their subdivision need not concern us. Table 1 in the occupational volume gives the totals of males and females in each of the 32 orders. It is possible, therefore, to find what proportions of persons in different occupations were enumerated in Poor Law Institutions, in Homes for Lunatics, and in Prisons.

In the first analysis males and females were combined, and the proportions in each of the main orders of occupations, expressed per 1,000 of the total persons so occupied, are shown in Table I under the three heads Poor Law, Lunatic, and Prison. The occupations are arranged in order, with abbreviated titles, those with the greatest number of their representatives economically, mentally, or morally invalidated coming at the top. The positions taken by some occupations are understandable, others are surprising. Let us look at the first eight in each list. Two occupations are common to all three lists, Poor Law, Lunacy, and Prison, namely *Undefined* and

TABLE I.—*Occupations arranged in order according to Number per 1,000 of Occupied enumerated in Poor Law Institutions, Lunatic Homes, and Prisons.*

[Both sexes combined.]

Poor Law.	No. per 1,000	Lunatic	No. per 1,000	Prison.	No. per 1,000
All occupations	5.25	All occupations	3.36	All occupations	0.631
Unoccupied	4.92	Unoccupied	3.98	Unoccupied	0.045
Undefined	18.9	Undefined	8.1	Entertainment and sport	1.92
Personal service	9.1	Personal service	7.0	Fishermen	1.72
Fishermen	9.0	Public administration, defence	6.7	Undefined	1.32
Painters and decorators	7.6	Dress	5.0	Painters and decorators	1.20
Builders and contractors	7.1	Skins and leather	4.7	Public administration, defence	1.13
Agriculture	6.4	Mixed materials	4.6	Transport and communication	1.11
Transport and communication	5.8	Fishermen	3.7	Builders and contractors	0.92
Dress	5.7	Watches, clocks, etc.	3.7	Stationary engines	0.88
Wood and furniture	5.3	Professional	3.3	Watches, clocks, etc.	0.68
Skins and leather	5.2	Painters and decorators	3.2	Commercial	0.67
Precious metals	4.7	Entertainment and sport	3.0	Metals	0.62
Mixed materials	4.6	Wood and furniture	2.9	Mines and quarries	0.59
Bricks, pottery, glass	4.3	Other materials	2.9	Mixed materials	0.59
Stationary engines	4.1	Paper, printing	2.6	Dress	0.57
Watches, clocks, etc.	4.1	Agriculture	2.4	Agriculture	0.56
Other materials	4.0	Precious metals ...	2.3	Electrical apparatus, etc.	0.55
Food, drink, tobacco	3.8	Bricks, pottery, glass	2.3	Wood and furniture	0.53
Textiles	3.6	Transport and communication	2.3	Precious metals	0.49
Metals	3.5	Textiles	2.3	Food, drink, tobacco	0.48
Paper, printing	3.4	Commercial	2.2	Skins and leather	0.45
Entertainment and sport	3.0	Food, drink, tobacco	2.2	Gas, water and electricity	0.43
Chemicals	3.0	Builders and contractors	2.0	Personal service	0.43
Treatment of non-metals	2.7	Clerks, typists	1.9	Chemicals	0.39
Gas, water, electricity	2.6	Metals	1.8	Paper, printing	0.35
Commercial ...	2.4	Stationary engines	1.6	Bricks, pottery, glass	0.34
Mines and quarries	2.4	Mines and quarries	1.5	Other materials	0.30
Storage and packing	2.2	Chemicals	1.5	Professional	0.30
Professional	1.3	Gas, water, electricity	1.5	Clerks, typists	0.28
Clerks, typists	1.2	Storage and packing	1.4	Storage and packing	0.21
Public administration, defence	1.1	Treatment of non-metals	1.3	Treatment of non-metals	0.18
Electrical apparatus, etc.	0.9	Electrical apparatus, etc.	0.9	Textiles	0.15

Fishermen. As the *Undefined* group is made up mostly of general labourers, it is not strange that it should be somewhere near the top. As to *Fishermen*, the number on which the proportions are calculated was the number enumerated at their homes on the Census night; no account is taken of fishermen who were at sea unless they arrived in port on the following morning. Hence the proportions of fishermen found in Poor Law Institutions, in Lunatic Homes, and in Prisons, so calculated, will be unduly exaggerated. To this point we shall return later when we come to consider males alone. Besides the two occupations already mentioned, we find three others common to the top eight in the Poor Law and Prison lists: *Builders and contractors*, *Painters and decorators*, *Transport and communication*. The first two are related occupations, and they have this in common, that they are seasonal and much affected by weather conditions. That might partly explain their position in the Poor Law list, and such irregular work might conduce to law-breaking. *Transport and communication* includes "Railwaymen, those engaged in road and motor transport, and other workers"; it thus contains certain markedly regular types with a small mixture of a casual type like the dock labourer. Again, there are two other occupations common to the first eight in the Poor Law and Lunacy lists: *Personal service* and the *Makers of articles of dress*; and there is one other occupation, *Public administration and defence*, common to the first eight in the Lunacy and Prison lists. *Public administration and defence* appears as the last item but one in the Poor Law list; that is not difficult to understand, since persons engaged in Public Administration or the Services seldom have an opportunity of going on the Poor Rate. As to the other two occupations they may be affected by sex differences, and we can leave them for the present.

Examining now the bottom eight in each list, it is somewhat surprising to find *Storage and packing* common to all three. One might have expected it at least to have come higher on the Prison list, seeing that by providing opportunities for dishonesty it would seem to lead people into temptation more easily than many other occupations. Common also to the Poor Law and Prison lists in the bottom eight we find *Clerks, typists, etc.* (which appears ninth from the bottom in the Lunacy list), and those engaged in *Professional occupations*, which one would expect. Common also to the bottom eight in the Lunacy and Prison lists we find those engaged in the *Treatment of non-metalliferous products of mines and quarries*, which again is only ninth from the bottom in the Poor Law list; while in the Poor Law and Lunacy lists there are three other occupations common to the bottom eight: *Electrical apparatus makers*,

those engaged in *Gas, water, and electricity undertakings*, and workers in *Mines and quarries*.

Tables II and III show the result of separating the sexes. Taking males first, we now find that three occupations appear in the top group of eight in all the lists, namely: *Undefined* (mainly general labourers), *Fishermen*, *Makers of textile goods and articles of dress*. The last named, which I have labelled shortly *Dress*, are not to be confused with those who work in textile factories, spinning and weaving the raw material: they come in another group labelled *Textiles*. *Makers of textile goods and articles of dress* include those who are concerned in the later processes of manufacturing dresses, costumes, millinery, and other articles of dress such as hats, gloves, boots, umbrellas.

In addition, *Painters and decorators* and those engaged in *Transport and communication* are common to the top group in the Poor Law and Prison lists, the former only failing by one place to appear in the top group in the Lunacy list also. Workers in *Skins and leather* is common to the first eight in the Poor Law and Lunacy lists, while *Public administration and defence* is in the first eight in the Lunacy and Prison lists. In a later part of the paper, Public Administration is separated from Defence, so that it is possible to see which is responsible for the higher position here taken.

Turning to the bottom group of eight, we again find three occupations common to all the lists: *Warehousemen, storekeepers and packers*, persons engaged in *Gas, water, and electricity undertakings*, workers in the *Treatment of non-metalliferous products of mines and quarries*. Further, *Clerks, typists, etc.*, is common to the Poor Law and Prison lists; *Electrical apparatus makers, fitters, electricians* and *Mining and quarrying* are common to the Poor Law and Lunatic lists; and workers in *Chemical processes* is common to the Lunatic and Prison lists.

Let us now examine the table for women, Table III. Here, three occupation orders are omitted: *Fishermen*, persons employed in *Gas, water, and electricity undertakings*, *Stationary-engine drivers, etc.*, because only an insignificant number of women was engaged in them. In the least important of the 28 occupations in the table, judging by the number of women occupied, there were 1,743 women enumerated. The more important women's occupations are printed in italics, and in each of these over 60,000 women were enumerated.

Common to the top seven of all three lists we find women engaged in *Personal service* (including those in institutions, clubs, hotels, etc., as well as domestic servants), those working in connection with *Mines and quarries*, in the manufacture of *Mixed materials* (not

TABLE II.—Occupations arranged in order according to Number per 1,000 of Occupied enumerated in Poor Law Institutions, Lunatic Homes, and Prisons.

[Males only]

Poor Law	No. per 1,000.	Lunatic.	No. per 1 000.	Prison.	No per 1 000
All occupations	5.41	All occupations	2.97	All occupations	0.821
Unoccupied	10.70	Unoccupied	8.75	Unoccupied	0.071
Undefined	19.6	Undefined	8.4	Entertainment and sport	2.56
Fishermen	8.9	Public administration, defence	7.6	Fishermen	1.74
Dress	8.3	Skins and leather	5.6	Undefined	1.38
Painters and decorators	7.7	Dress	4.7	Dress	1.35
Builders and contractors	7.1	Watches, clocks, etc.	3.9	Public administration, defence	1.31
Agricultural	6.5	Other materials	3.5	Painters and decorators	1.21
Skins and leather	6.3	Fishermen	3.4	Transport and communication	1.15
Transport and communication	6.0	Mixed materials	3.3	Personal service	0.99
Wood and furniture	5.4	Painters and decorators	3.2	Builders and contractors	0.92
Personal service	5.2	Wood and furniture	2.9	Commercial	0.91
Precious metals	5.2	Entertainment and sport	2.8	Stationary engines	0.88
Bricks, pottery, glass	5.1	Personal service	2.8	Watches, clocks, etc.	0.74
Food, drink, tobacco	4.8	Paper, printing	2.8	Precious metals	0.68
Other materials	4.5	Bricks, pottery, glass	2.7	Metals	0.66
Watches, clocks, etc.	4.3	Clerks, typists	2.7	Food, drink, tobacco	0.66
Mixed materials	4.3	Food, drink, tobacco	2.6	Skins and leather	0.63
Stationary engines	4.1	Professional	2.6	Mixed materials	0.61
Textiles	4.1	Commercial	2.5	Electrical apparatus, etc.	0.60
Paper, printing	4.0	Agricultural	2.4	Agricultural	0.59
Metals	3.5	Transport and communication	2.4	Mines and quarries	0.59
Entertainment and sport	3.5	Precious metals	2.3	Professional	0.57
Chemicals	3.1	Builders and contractors	2.0	Wood and furniture	0.54
Commercial	3.0	Textiles	2.0	Paper, printing	0.51
Treatment of non-metals	2.8	Metals	1.8	Bricks, pottery, glass	0.48
Gas, water, electricity	2.6	Storage and packing	1.7	Other materials	0.46
Storage and packing	2.6	Stationary engines	1.6	Clerks, typists	0.46
Mines and quarries	2.4	Mines and quarries	1.5	Gas, water, electricity	0.44
Clerks, typists	1.9	Gas, water, electricity	1.4	Chemicals	0.42
Professional	1.3	Treatment of non-metals	1.4	Storage and packing	0.30
Public administration, defence	1.2	Chemicals	1.2	Textiles	0.29
Electrical apparatus, etc.	0.9	Electrical apparatus, etc.	1.0	Treatment of non-metals	0.19

TABLE III.—*Occupations arranged in order according to Number per 1,000 of Occupied enumerated in Poor Law Institutions, Lunatic Homes, and Prisons.*

[Females only. The more important occupations in italics.]

Poor Law.	No. per 1,000.	Lunatic.	No. per 1,000.	Prison.	No. per 1,000.
All occupations	4·89	All occupations	4·32	All occupations	0·182
Unoccupied	3·95	Unoccupied....	3·18	Unoccupied	0·041
Mines and quarries	10·4	Mixed materials	9·7	Mixed materials	0·48
<i>Personal service</i>	9·9	<i>Personal service</i>	7·8	Entertainment and	
Undefined ...	5·9	<i>Dress</i>	5·1	sport	0·39
Mixed materials	5·8	<i>Professional</i>	4·0	Wood and furniture	0·34
<i>Agriculture</i> ...	5·6	Undefined	3·4	<i>Personal service</i>	0·31
<i>Dress</i>	4·3	Entertainment and		Mines and quarries	0·30
Painting and deco-		sport	3·2	Chemicals	0·26
rating ..	3·8	Mines and quarries	3·0	Undefined	0·21
Precious metals	3·7	Wood and furniture	3·0	<i>Agriculture</i>	0·20
Wood and furniture	3·6	Chemicals	2·6	Electrical	0·20
Other materials	3·3	<i>Textiles</i>	2·5	<i>Commercial</i>	0·17
<i>Textiles</i> ..	3·2	<i>Agriculture</i>	2·4	<i>Dress</i>	0·16
Building ..	2·9	Precious metals	2·4	<i>Metals</i>	0·16
Chemicals ...	2·7	<i>Paper, printing</i>	2·3	Precious metals	0·13
<i>Metals</i>	2·7	Skins and leather	2·2	<i>Food, drink, tobacco</i>	0·13
Bricks, pottery, glass	2·6	Watches, clocks, etc.	2·1	<i>Paper, printing</i>	0·10
<i>Paper, printing</i>	2·3	Other materials	2·0	Other materials	0·08
Skins and leather	2·2	<i>Commercial</i>	1·6	<i>Transport and com-</i>	
Treatment of non-		<i>Metals</i>	1·5	munication	0·08
metals ...	2·1	Bricks, pottery, glass	1·5	<i>Textiles</i>	0·07
<i>Food, drink, tobacco</i> ...	1·9	Painting and deco-		<i>Professional</i>	0·07
Entertainment and		rating	1·4	<i>Storage and packing</i>	0·06
sport ..	1·8	<i>Food, drink, tobacco</i>	1·3	<i>Clerks, typists</i>	0·05
Watches, clocks, etc.	1·6				
<i>Transport and com-</i>		<i>Transport and com-</i>		Bricks, pottery, glass	0·05
munication	1·5	munication	1·1	<i>Public administration</i>	0·04
<i>Storage and packing</i> ...	1·5	<i>Public administration</i>	1·0	Treatment of non-	
<i>Professional</i>	1·3	<i>Storage and packing</i>	0·98	metals	0·00
<i>Commercial</i> ..	1·3	<i>Clerks, typists</i>	0·95	Watches, clocks, etc.	0·00
<i>Public administration</i>	0·67	Building	0·58	Skins and leather	0·00
Electrical ..	0·49	Treatment of non-		Building	0·00
<i>Clerks, typists</i>	0·24	metals	0·53	Painting and deco-	
		Electrical	0·10	rating	0·00

elsewhere enumerated, such as musical instruments, vehicles, ships and boats). and the *Undefined* group, the majority of which are "Out of work (not otherwise described), General labourers or unskilled workers, and Rag, bone and bottle sorters." Besides these four occupations we find *Dress* also common to the Poor Law and Lunatic lists, and *Entertainment and sport* common to the Lunatic and Prison lists.

High as is the position of *Personal Service* on all the lists, the figures for *Indoor domestic servants* alone (Poor Law, 11.0; Lunatic, 9.0; Prison, 0.33) would have raised it still higher.

In the bottom group we find *Public administration* common to all three lists, and *Clerks and typists* only fails by one to be common to all three, coming eighth from the bottom in the Prison list. *Transport and communication*, *Storage and packing*, and *Electrical apparatus makers and fitters* are, in addition to the occupations already named, common to the bottom group in the Poor Law and Lunatic lists; while *Building* and the *Treatment of non-metalliferous products of mines and quarries* are common in the Lunatic and Prison lists.

It is interesting and unexpected to find so much agreement between corresponding lists for males and for females, although it must be borne in mind that men and women seldom do exactly the same work even when they are classed under the same occupation heading. Nevertheless there must be many conditions to which they are subject in common when they are engaged in similar work. The fact that so frequently the same occupations are found towards the top or towards the bottom of corresponding lists for both sexes suggests that the cause is to be found in certain of those common conditions, whatever they may be.

It is unnecessary, and it would be tedious, to point out in detail the many similar features in Tables III and IV. It may be worth mentioning, however, that the disagreement noticeable in the position of *Public administration* in the Lunatic and Prison lists in the two tables is due to the inclusion of *Defence* in the same group in the case of men. This will be clear when the two occupations are separated later.

The amount of agreement found in the three lists for both sexes suggested that something more than mere chance must be accountable for the order shown, and it seemed worth while to try and discover if there was any stability about it. Should we find the same occupations near the top in each list and the same occupations near the bottom if we had corresponding figures for other years?

Now similar tables are given in the Census records for 1911 and 1901, and an attempt has been made to work out proportions which

should be reasonably comparable for the three years 1921, 1911 and 1901. Were we concerned with the two earlier years alone this would not be a difficult matter, because there is very little difference between these two years in the grouping and contents of the occupations which comprise the main orders. The changes made in 1921, however, are more serious. The preface to the volume on Occupations (1921) contains the following warning paragraph: "The new classification of occupations differs fundamentally from that of any previous Census, chiefly in being purely occupational. Considerations of an industrial nature, which largely governed previous classifications, are now left entirely to the independent classification by industries. It follows that little comparison can be made between the numbers returned under occupational headings in 1921 and at previous Censuses. The principle upon which the classification is based is the nature of the work performed, though, in the case of the productive occupations, the nature of the material worked in has been embodied in the scheme as a factor essentially determining the character of the operations."

In spite of this warning, I have had the temerity to see what can be got out of the figures, and, after making such adjustments as seemed reasonable, I venture to think that comparison with the earlier years is not altogether without value. My reason for this conclusion will appear when the results themselves are studied. If we find a certain measure of agreement between the results in 1901 and 1911, years when we know that the classification of occupations was on practically the same basis, and if we find that a similar measure of agreement subsists between 1921 and the earlier years, I think we may fairly assume that the adjustments made with a view to comparability are, on the whole, satisfactory.

An examination of the detailed contents of each order of occupations in the three years reveals the fact that those which are described in similar terms contain substantially the same types of worker. In the comparatively few cases where it was clear that a sub-group had been transferred from one order of occupations to another, comparing one year with another, it was possible to make a readjustment; the chief adjustment required, and the one which was most troublesome, was due to the fact that the dealers in different kinds of commodities were placed, in 1901 and 1911, along with the makers of the same commodities in different classes—thus, dealers in Chemicals were classed with the makers of Chemicals, and dealers in Paper with the makers of Paper—whereas in 1921 all dealers were separated from makers and included together in the order defined as *Commercial, finance and insurance occupations*. As, however,

dealers were in the great majority of cases differentiated from makers, even in 1901 and 1911, though placed in the same occupation group, it was possible to abstract them and to transfer them to the commercial group in those years. The key to this and all other adjustments of like kind is given in Table IV, which will enable the reader, if he desires, to study the basis of comparability between the three years in detail.

Corresponding adjustments were of course necessary in the numbers of persons from the various occupation orders enumerated in Poor Law Institutions, Lunatic Homes, and Prisons. These figures were not always given in the same detail, and when that happened one had also to be satisfied with a less complete adjustment of the number occupied than would have been otherwise possible. The point to bear in mind is that, however one year may differ from another in the contents of any occupation group, it is essential that the *total* occupied and the *fraction of that total* found in Prison, or wherever it might be, should in *any one year* refer to precisely the same people, and this is achieved so far as the Census records themselves are trustworthy.

TABLE IV.—*Chief Occupation Orders, 1901, 1911, 1921, adjusted so as to render Number of Occupied Males in each, so far as possible, comparable.*

[The sign — before any group signifies its omission, the sign + its inclusion ;
D signifies dealers.]

Description of Occupation Order.		Number of Occupation Order		
1921.	1901 and 1911.	1921	1901	1911.
Fishermen.	Fishing.	1	8	8
Agricultural.	Agriculture.	2	7	7
Mining and quarrying. Workers in the treat- ment of non-metalli- ferous mine and quarry products. }	In and about, and working in the products of mines and quarries, <i>ex- cept</i> dealers. }	3 4	9—9(1)D, (2)D.	9—9(2)D.
Makers of bricks, pottery and glass.	Brick, cement, pot- tery, and glass, <i>ex- cept</i> dealers in 1911.	5	14	14—14(1)7, 8D.
Workers in chemical pro- cesses ; makers of paints, oils, etc.	Chemicals, oil, grease, soap, resin, etc., <i>except</i> dealers.	6	15—15(3)D, (4)D.	15—15(3)4D, (4)8, 9D.

TABLE IV (Contd.).—*Chief Occupation Orders. 1901, 1911, 1921, adjusted so as to render Number of Occupied Males in each, so far as possible, comparable.*

Description of Occupation Order.		Number of Occupation Order		
1921.	1901 and 1911.	1921.	1901.	1911.
Metal workers (not electro-plate or precious metals).	Metals, machines, implements, and conveyances, <i>except</i> electrical apparatus, and dealers.	7	10—10(10)D.	10—10(4)—10(11)D.
Workers in precious metals and electro-plate.	Precious metals, jewels, watches, instruments, and games. <i>except</i> dealers in 1911.	8	11	11—11(5)D.
Makers of watches, clocks, and scientific instruments.		10		
Surgical - instrument makers and workers.		20(4)		
Electrical apparatus makers and fitters, and electricians.	Electrical apparatus (1911 only).	9	—	10(4).
Workers in skins and leather, and makers of leather and leather substitute goods (not boots or shoes).	Skins and leather, <i>except</i> dealers.	11	16—16(3)—16(4)D.	16—16(3)—16(4)D.
Textile workers.	Textile fabrics, <i>except</i> dealers.	12	18—18(7)D.	18—18(7)D.
Makers of textile goods and articles of dress.	Dress, <i>except</i> dealers.	13	19—19(1)D.	19—19(1) 7, 9, 15, 19, 24D.
Makers of foods, drinks, and tobacco.	Food, tobacco, drink, <i>except</i> dealers.	14	20—20(4)—20(1)D.	20—20(4)—20(1) 2, 4, 6, 8, 10, 16, 17, 20D.
Workers in wood and furniture.	Wood, furniture, fittings and decorations, <i>except</i> dealers	15	13—13(1)D, (2)D.	13—13(1), 8, 9D, (2)8D.
Makers of and workers in paper; printers, bookbinders, photographers, etc.	Paper, prints, books, and stationery; photographers; <i>except</i> dealers.	16	17—17(1)D, (2)D	17+3(7)4—17(1)8, 9D, (2)8, 9, 10D.
Builders, bricklayers, stone and slate workers; contractors.	Building and works of construction, <i>except</i> paperhangers, whitewashers, painters, decorators, and glaziers.	17	12—12(1) (part)	12—12(1)12, 13, 14.

TABLE IV (Contd.).—*Chief Occupation Orders, 1901, 1911, 1921, adjusted so as to render Number of Occupied Males in each, so far as possible, comparable.*

Description of Occupation Order.		Number of Occupation Order.		
1921.	1901 and 1911.	1921	1901	1911.
Painters and decorators.	Paperhangers, white-washers, painters, decorators, and glaziers.	18	12(1) (part)	12(1)12, 13, 14.
Persons employed in gas, water, and electricity undertakings (not elsewhere enumerated).	Gas, water, and electricity supply, and sanitary service.	21	21	21
Persons employed in transport and communication.	Conveyance of men, goods, and messages.	22	6	6
Warehousemen, store-keepers, and packers.		29		
Commercial, finance, and insurance occupations.	Commercial occupations (includes clerks and all dealers excepted from other orders).	23	5+all D's excepted from other orders.	5+all D's excepted from other orders.
Clerks and draughtsmen (not Civil Service or Local Authority); typists.		28		
Persons employed in public administration.	General or local government of the country.	24(1)	1	1
Persons employed in defence.	Defence of the country	24(2)	2	2
Professional occupations (excluding clerical staff).	Professional occupations and their subordinate services.	25	3—3(7) (part) —3(8)	3—3(7)4, 5, 6, 7—3(8)1.
Persons employed in entertainments and sport.	Music, drama, exhibitions, games, etc.	26	3(7) (part), 3(8)	3(7)5, 6, 7; 3(8)1.
Persons engaged in personal service (including institutions, clubs, hotels, etc.).	Domestic offices or services; board, lodging, and dealing in spirituous drinks.	27	4+20(4)	4+20(4).
Stationary-engine drivers, dynamo and motor attendants.	Engine-drivers, stockers, firemen (not railway, marine, or agricultural).	30	22(4) (part)	22(5)2.
General or undefined labourers.	General or undefined labourers.	31 (part)	22(4) (part)	22(5)1.

In a few cases two or more groups or orders of occupations have been combined in 1921 to correspond with the classification of the earlier years where no clear line was drawn between the groups: for example, orders 3 and 4 in 1921, *Mining and quarrying* and *Treatment of non-metalliferous products of mines and quarries*, were combined to correspond to order 9 in 1901 and 1911, defined as *In and about and working and dealing in the products of mines and quarries*; but, in addition, the dealers in the last-named group were transferred to the commercial group in 1901 and 1911. Order 24, on the other hand, *Public administration and defence* (1921), was split up into the two separate groups of *Public administration* and *Defence*, which are classified as *General or local government of the country*, order 1, and *Defence of the country*, order 2, in the earlier years. All groups except *General or undefined labourers* were omitted from order 31 (1921) and order 22 (1901, 1911), because the numbers were relatively small and they were heterogeneous in character. The net result of these alterations is that we are left with 26 main orders of occupations, which are all pretty clearly defined and, therefore, it is judged, not incomparable.

To avoid sex differences, and because in some occupations the number of women engaged is comparatively small, the remainder of this analysis refers to males alone. The titles of the several occupation orders have been somewhat abbreviated, for economy in printing, but a sufficient description is given to enable anyone who desires to examine their contents in detail to trace them quite readily. Order 31 (1921), as explained, contains only *Labourers*, and is so defined.

Before proceeding to compare results in the three years, a few remarks are necessary as to the procedure followed in classifying persons in Poor Law Institutions, in Lunatic Homes, and in Prisons. There are some slight differences between the procedure in 1921 and in the earlier years, and these differences, such as they are, affect the large totals allocated to various occupations on which the subsequent proportions are calculated, but I do not think that they are serious enough to vitiate the comparisons ultimately made.

Between 1901 and 1911 there is no difference. In those years, *Prisoners* of all ages, on the assumption that their ordinary work was only relinquished for a time, were classified according to their usual occupation. The same holds for 1921, except that the inmates of convict prisons were coded as *Retired*.

Inmates of Lunatic Asylums or of Workhouses, when described as *Insane* and as having formerly followed some occupation, were classed as *Retired* in 1901 and 1911. In 1921, also, all inmates of

Mental Hospitals, Mentally Deficient Homes, and Lunatic Asylums were coded as Retired, even when their previous occupations were given. In each of the three years, therefore, the total of males found in Lunatic Homes and other such Institutions was subtracted from the Retired or Unoccupied total (Order 32 in 1921, Order 23 in 1901 and 1911) and redistributed among the occupations formerly followed, and the calculations of the proportions of different occupations found in such institutions were only made after this adjustment. It should be noted in passing that a corresponding redistribution was not made before calculating the results in Tables I-III; in those tables the persons found in Lunatic Homes are therefore not included in the totals on which the proportions are based.

In 1901 and 1911, the inmates of Workhouses or Workhouse Infirmaries, if aged 60 or upwards, were classed as Retired; in 1921 all inmates of *Poor Law* Institutions, aged 70 years and over, were coded as Retired, even when the previous occupations were given. It was possible to re-distribute those in Poor Law Institutions who had been classed as Retired in 1901 and 1911 among the occupations they formerly followed, as in the case of persons in Lunatic Homes, but the data were not available for this to be done in 1921. As, however, so many poor people over 70 can now escape the workhouse with the help of the old-age pension, the difference between the procedure in 1921 and in the earlier years is probably not very material.

Tables V-VII show, side by side, the proportions of males per 1,000 of those occupied (after adjustment) in each of the three years found in Poor Law Institutions, in Lunatic Homes, and in Prisons, respectively. The occupation orders are divided into four groups, of 7, 6, 6, and 7 orders, those with the highest proportions segregated coming in the top group and those with the lowest proportions segregated coming in the bottom group. The order defined as "Electrical apparatus makers and fitters, electricians" only comes into existence in 1911, which has the effect of making the bottom group one order short in the Poor Law and Lunatic lists in 1901 and the third group one order short in the Prison list in the same year.

With regard to *Fishermen*, it has been already pointed out that those who were at sea on the night of the Census and did not arrive in port on the following morning are not included in the occupation return, but statistics relating to them are furnished by the Registrar-General of Shipping and Seamen in an Appendix to the General Tables for England and Wales in 1921. If we add the number there given to the number enumerated in the Census, the total of fishermen for 1921 is raised from 28,808 to 31,174. The Census numbers for

1901 and 1911, namely 23,725 and 25,139, have been increased in the same proportion, so giving rough estimates of 25,700 and 27,200 for the totals of fishermen in those two years. The proportions of fishermen segregated are thus reduced and the revised figures in each case are bracketed with the original ones; it will be observed that the position taken by fishing is not materially affected by this adjustment in any of the lists.

TABLE V.—*Occupations arranged in order according to the Proportion per 1,000 of Males so Occupied found in Poor Law Institutions.*

1921.		1911.		1901.	
Occupation.	Proportion per 1,000.	Occupation.	Proportion per 1,000.	Occupation.	Proportion per 1,000.
Labourers	23·1	Labourers	80·0	Labourers	51·7
Fishing ... {	8·9	Fishing {	18·7	Painters and deco-	
Dress	8·2	rators	17·2	rators	14·7
Painters and deco-	8·3	Painters and deco-		Dress	13·6
rators		rators	18·1	Wood, furniture ...	11·4
Building	7·7	Building	15·4	Agriculture ...	10·4
Agriculture	7·1	Dress	13·9	Fishing .. {	9·7
Skins and Leather ...	6·5	Wood, furniture ..	13·8	Building	9·0
	6·3	Skins and leather ...	13·1		9·4
Transport	5·5	Agriculture ...	12·5	Skins and leather ..	9·1
Wood, furniture ...	5·4	Paper, print ...	12·0	Transport	8·2
Personal service ...	5·2	Transport	11·7	Sport	8·0
Bricks, pottery, glass	5·1	Bricks, pottery, glass	9·4	Textiles	7·2
Food, drink, tobacco	4·8	Metals	8·7	Metals	6·6
Watches	4·5	Watches	8·6	Bricks, pottery, glass	5·6
Stationary - engine		Food, drink, to-		Food, drink, to-	
drivers	4·1	bacco	8·0	bacco	5·6
Textiles	4·1	Stationary - engine		Paper, print ...	5·5
Paper, print	4·0	drivers	7·2	Personal service	5·5
Metals	3·5	Personal service ...	6·9	Stationary - engine	
Sport	3·5	Textiles	6·7	drivers	5·4
Chemicals	3·1	Gas, water, elec-		Watches	4·7
		tricity	4·3	Chemicals	3·7
		Sport	4·3		
Gas, water, elec-		Chemicals	4·2	Gas, water, elec-	
tricity	2·6	Mines	3·9	tricity	3·4
Commercial and		Commercial and		Commercial and	
clerical	2·6	clerical	3·7	clerical	3·1
Mines	2·4	Professional ...	2·8	Mines	2·6
Defence	1·4	Defence	2·0	Professional ...	2·3
Professional	1·3	Electrical	1·7	Defence	1·7
Electrical	0·9	Public administra-		Public administra-	
Public administration	0·9	tion	1·2	tion	0·9

TABLE VI.—Occupations arranged in order according to the Proportion per 1,000 of Males so Occupied found in Lunatic Homes.

1921.		1911.		1901.	
Occupation.	Proportion per 1,000.	Occupation.	Proportion per 1,000.	Occupation.	Proportion per 1,000.
Defence	15.1	Labourers	26.4	Labourers	14.3
Labourers	9.7	Defence	5.8	Defence	5.3
Skins, leather	5.6	Dress	5.4	Dress	4.8
Dress	4.7	Skins, leather	4.9	Painters and deco-	
Watches	3.9	Painters and deco-		rators	3.9
Fishing	3.4	rators	4.9	Wood, furniture	3.9
Painters and deco-	3.1	Wood, furniture	4.5	Skins, leather	3.6
rators	3.2	Watches	4.3	Sport	3.6
Wood, furniture	2.9	Paper, print	3.9	Fishing	3.4
Sport	2.8	Professional	3.8		3.2
Personal service	2.8	Sport	3.7	Paper, print	3.2
Paper, print	2.8	Fishing	3.7	Agriculture	3.0
Bricks, pottery, glass	2.7		3.4	Watches	2.8
Food, drink, tobacco	2.6	Agriculture	3.2	Textiles	2.8
		Building	3.2	Professional	2.6
Professional	2.6	Food, drink, to-		Food, drink, tobacco	2.6
Commercial and		bacco	3.1	Commercial and	
clerical	2.6	Transport	2.8	clerical	2.5
Agriculture	2.4	Commercial and		Transport	2.4
Transport	2.3	clerical	2.7	Building	2.3
Building	2.0	Bricks, pottery, glass	2.6	Metals	2.2
Textiles	2.0	Textiles	2.5	Stationary - engine	
		Metals	2.4	drivers	2.2
Metals	1.8	Personal service	2.4	Bricks, pottery, glass	1.9
Stationary - engine		Stationary - engine		Personal service	1.8
drivers	1.6	drivers	2.2	Public administra-	
Mines	1.5	Public administra-		tion	1.7
Gas, water, elec-		tion	2.0	Mines	1.7
tricity	1.4	Mines	1.9	Chemicals	1.4
Chemicals	1.2	Gas, water, elec-		Gas, water, elec-	
Electrical	1.0	tricity	1.4	tricity	1.4
Public administra-		Chemicals	1.2		
tion	1.0	Electrical	1.1		

TABLE VII.—*Occupations arranged in order according to the Proportion per 1,000 of Males so Occupied found in Prisons.*

1921.		1911.		1901.	
Occupation.	Proportion per 1,000.	Occupation.	Proportion per 1,000.	Occupation.	Proportion per 1,000.
Sport	2.55	Labourers	7.96	Labourers	7.80
Defence	2.37	Fishing	3.96	Defence	6.01
Fishing	1.73	Painters and deco- rators	3.66	Painters and deco- rators	2.78
Labourers	1.60		3.04	Fishing	2.21
Dress	1.62	Sport	2.71	Dress	2.05
Painters and deco- rators	1.34	Dress	2.44	Building	2.10
Transport	1.21	Building	2.32	Transport	1.56
	1.03	Transport	1.72		1.35
Personal service	0.98	Food, drink, to- bacco	1.43	Sport	1.20
Building	0.92	Wood, furniture	1.30	Wood, furniture	1.15
Stationary - engine drivers	0.88	Paper, print	1.20	Metals	0.96
Commercial and clerical	0.75	Stationary - engine drivers	1.16	Stationary - engine drivers	0.91
Watches	0.74	Metals	1.06	Food, drink, to- bacco	0.91
Food, drink, to- bacco	0.66	Skins, leather	1.06	Personal service	0.90
Metals	0.66	Mines	1.01	Watches	0.90
Skins, leather	0.62	Personal service	0.95	Commercial and clerical	0.76
Electrical	0.60	Watches	0.92	Mines	0.76
Agriculture	0.59	Bricks, pottery, glass	0.92	Professional	0.73
Mines	0.58	Electrical	0.84	Paper, print	0.71
Professional	0.57	Gas, water, elec- tricity	0.82		
Wood, furniture	0.54	Commercial and clerical	0.81	Skins, leather	0.69
Paper, print	0.51	Agriculture	0.76	Gas, water, elec- tricity	0.60
Bricks, pottery, glass	0.48	Defence	0.66	Bricks, pottery, glass	0.59
Gas, water, elec- tricity	0.44	Textiles	0.58	Textiles	0.56
Chemicals	0.42	Professional	0.57	Agriculture	0.40
Public administra- tion	0.37	Chemicals	0.46	Chemicals	0.39
Textiles	0.29	Public administra- tion	0.29	Public administra- tion	0.38

When we come to compare the three years, the amount of agreement in the top and bottom groups of occupations, whichever list we examine, is remarkable, though we must discount something from it, because some of the 1921 inmates of the different institutions were no doubt inmates also in 1911 and some even in 1901. *Five occupations are common to the top group in all three lists. Further, three of these five occupations are the same in all three years in all the lists, namely, Labourers, Painters and decorators, and Makers of articles of dress.* The other two occupations common to the three years in the top group are *Building* and *Fishing* (or *Skins and leather*, if we take the revised figures for *Fishing*) in the Poor Law list, *Defence* and *Skins and leather* in the Lunacy list, and *Transport* and *Fishing* in the Prison list. Even this does not exhaust the measure of agreement, but it must be left to the reader to note how frequently in each list occupations which are not common to the top group in the three years are usually common to it in at least two years out of the three, and only just fail to get into the top group in the third year.

Turning now to the bottom group, we again find five occupations common to all three years in the Poor Law list, or six if we include *Electrical*, which is common to 1911 and 1921 but did not exist in 1901; the other five occupations are *Public administration*, which is common to all the lists in all three years, *Professional*, *Defence*, *Mining*, *Commercial and clerical*. There are four occupations common to all three years in the Lunacy list, or five if we include *Electrical*; the other four are *Public administration*, *Chemicals*, *Gas, water and electricity*, *Mining*. There are three occupations common to all three years in the Prison list. *Public administration*, *Textiles*, *Chemicals*. Here again it is worth noting how certain occupations which are common to the bottom group in two out of the three years in each list often only just fail to get into the bottom group in the third year.

It will probably surprise no one to find *Labourers* coming at the top of the list and *Public administration* at the bottom. To *Painting and decorating* and *Building* we have previously referred: they are about the most seasonal in character of all large industrial groups, and that might explain, as has been suggested, their appearance high in the Poor Law list each year; but *Painting and decorating* remains in the top group in the Lunatic list, while *Building* sinks there to the level of the third group down. Also, other occupations are affected by the seasons, though perhaps not to the same degree, and we do not find them always high even in the Poor Law list.

Again, changes in fashion probably affect the *Makers of articles of dress* more than any other occupational group, and that might be

held to account for their high position in all three lists : but a little doubt is thrown on this conclusion when we find, for instance, that *Textiles*, another great branch of the same industry but at a stage further back in the process of production, appears at about the third or fourth group level in each list, although, if we consider occupied women instead of men, Table III places it somewhat higher. It might be suggested that, the earlier the stage in the process of production, the more stable are the conditions of industry ; but, if we push the stage further back still, and compare the different extractive industries, we find that *Fishing* is high and *Mining* is low in all the lists ; while *Agriculture* is high in the Poor Law list, about half-way down in the Lunatic list, and near the bottom in the Prison list.

We might be tempted to attribute the place that *Transport* takes in the top group each year in the Prison list to exceptional opportunities for theft, were it not for the recollection that *Storage and packing*, with opportunities which are somewhat similar, came consistently in the bottom group in Tables I and II. The *Commercial and clerical* group, including dealers of all kinds, also occupies a comparatively low place in the Prison list.

The position of *Defence* in the Poor Law list, as already explained, is no matter for surprise, but it does not speak well for conditions of life in the Services that we should find this occupation easily top of the Lunatic list in 1921 and second only to *Labourers* in 1901 and 1911. The effects of war may account for much ; but will that explanation apply in 1911 ? It certainly looks as if we might blame evil war-time experiences, as opposed to the discipline of peace, for pushing *Defence* up to the second position in the Prison list in 1901 and 1921, for the same occupation is in the bottom group in 1911.

It is encouraging to find that the important occupations of *Mining* and *Textiles* are among those which receive honourable mention as coming towards the bottom in one or more lists in all three years, especially when we reflect that the birth-rate in the *Mining* section of the community has for some time been appreciably above the average level for the whole population, although the very reverse is true of the *Textile* section.

Substantially all employed persons earning below a certain income must now be insured against unemployment. Persons employed in domestic service and in agriculture are exceptions to this rule, and they are therefore in this respect at a disadvantage relative to persons engaged in other occupations. This is reflected in the somewhat higher positions taken by *Personal service* and *Agriculture* in the Poor Law and Prison lists in 1921 as compared with 1911.

Incidentally, it will be noted that the proportions generally are appreciably higher in all three lists in 1911 than in 1901 and 1921. Taking all occupied males together, the proportions per 1,000 found in different institutions work out as follows :—

	1901.	1911	1921
<i>Poor Law</i>	8.85	10.55	5.41
<i>Lunatic</i>	3.16	3.64	2.97
<i>Prison</i>	1.39	1.44	0.82

These figures are in keeping with similar statistics for all persons in England and Wales. Thus, the mean numbers of persons in receipt of institutional relief, per 1,000 of the population, in the years ended March, 1901, 1911 and 1921, respectively, were recorded as 5.8, 7.7 and 5.1, respectively; the average numbers of insane persons, per 1,000 of the population, confined in asylums, lunatic homes, etc., in the same three years were 2.66, 3.05 and 2.69; and the proportions, per 1,000 of the population, of persons tried for indictable offences at Assizes and Quarter Sessions were 0.33, 0.36, and 0.24. It will be remembered that the first National Insurance Act came into force in 1912, and the cumulative effect of that, and subsequent Acts in ameliorating the condition of the working classes, is no doubt largely responsible for the improvement shown in 1921.

We have so far been studying the correlation between the proportions per 1,000 males in different occupations found in Poor Law, Lunatic, and Prison Institutions in 1901, 1911, and 1921 by a common-sense method, so to speak, which took note simply of those occupations which tended to the top of the lists and of those which tended to the bottom in each year. The extent of agreement between the lists was so striking that it seemed worth while to calculate the coefficients of correlation, relating one year to another for each type of institution, and relating one type of institution to another for each year.

In calculating the correlation between the proportions of the several occupations found in one type of institution and another, the occupation *Defence* was omitted, because soldiers and sailors, when in service, are not dealt with in the ordinary way by our civilian Poor Law and Prison Authorities. But, in calculating the correlation between the proportions found in one year and another, *Defence* was not omitted, because it was presumed that one year would not differ sensibly from another in the frequency with which soldiers and sailors would find their way somehow into the hands of the ordinary Poor Law or Prison Authorities, other things being equal.

The results of these calculations are shown in Tables VIII and IX. Several of the coefficients obtained are extraordinarily high, all in fact which do not refer to 1921, but some of these too are high, e.g. $r_{1901, 21}$ and $r_{1911, 21}$ in the Poor Law series, and $r_{PL, L}$ in 1921.

The Table VIII results are consistent and regular: the Poor Law coefficients are highest throughout, the Prison coefficients are lowest; also, the years 1901 and 1911 are most closely related throughout, the years 1911 and 1921 are least closely related. It is natural that 1901 and 1911 should be more closely connected than other years because of the very little change in the classification of occupations between those two years; but, except for the possible influence of war or post-war conditions upon the figures, one would have anticipated a closer connection between 1921 and 1911 than between 1921 and 1901, and all the more because, as already pointed out, a certain number of inmates in each type of institution may be regarded as permanent residents who would appear in the records of successive Censuses. This last fact would also have led us to expect the Lunatic to be rather higher than the Poor Law coefficients. The gaps between $r_{1901, 21}$ and $r_{1911, 21}$ are not greater than might be bridged by differences due to random sampling, as the probable errors indicate, but the gaps between the Lunatic and Poor Law coefficients are more pronounced. Again, in so far as administration is concerned, one might have anticipated that the order among institutions would be just the reverse of what we find, seeing that the rules which regulate the administration of the law are more rigidly defined than those which regulate the administration of the Poor Law, while admissions into Lunatic Asylums are largely independent of human administration; but, of course, administration is only one, though sometimes an important, factor influencing the result.

Correlations between Proportions per 1,000 Males in Different Occupations found in Poor Law, Lunatic, and Prison Institutions in 1901, 1911, 1921.

TABLE VIII.—*One Year related to Another, for Each Type of Institution.*

	Poor Law.	Lunatic	Prison.
$r_{1901, 11}$.	0.98 ± 0.01	0.98 ± 0.01	0.74 ± 0.06
$r_{1901, 21}$. . .	0.97 ± 0.01	0.66 ± 0.08	0.65 ± 0.08
$r_{1911, 21}$	0.97 ± 0.01	0.59 ± 0.09	0.53 ± 0.10

TABLE IX.—*One Institution related to Another, for Each Year.*

	1901.	1911.	1921.
$r_{PL, L}$	0.97 ± 0.01	0.97 ± 0.01	0.88 ± 0.03
$r_{PL, P}$	0.96 ± 0.01	0.91 ± 0.02	0.47 ± 0.10
$r_{L, P}$	0.94 ± 0.02	0.88 ± 0.03	0.44 ± 0.11

TABLE X.—*Partial Correlations.*

	1901.	1911.	1921.
$r_{P, L}$ (PL constant)	+ 0.13	— 0.10	+ 0.01
$r_{PL, L}$ (P constant)	+ 0.72	+ 0.41	+ 0.85
$r_{PL, P}$ (L constant)	+ 0.57	+ 0.54	+ 0.19

The coefficients in Table IX are also regular: they decrease from row to row in each column, and from column to column in each row, although the values of $r_{PL, P}$, and $r_{L, P}$ in 1921 differ considerably from the other coefficients in the table.

The partial correlation coefficients in Table X suggest that pauperism is the connecting link between crime and lunacy, for if we could fix the amount of pauperism prevailing in different occupations at a common level, there would then appear to be no relation between the occupational incidence of lunacy and crime, as judged by the numbers of paupers, lunatics, and criminals found in different institutions.

Taking all the tables together, two results clearly emerge: (1) The occupations which are most frequently represented, in proportion to the numbers occupied, in one kind of institution tend also to be most frequently represented in the others, and *vice versa*. (2) This does not seem to be a chance occurrence. Whether we consider proportional frequency of representation in Poor Law Institution, or Lunatic Home, or Prison, the same occupations tend persistently to come to the top while others tend persistently to sink to the bottom in each year.

It is interesting to speculate whether this is due to some peculiarity in the nature of the occupations concerned, or whether persons who are economically, mentally, or morally unstable drift into one occupation rather than another. There is something in the force of example: for this and other reasons lads frequently follow in their fathers' footsteps and take up the same occupation. If, then, heredity counted for anything, it is not inconceivable that certain types of invalidity, given a start, might in course of time become concentrated in some occupations rather than in others. It is clear that any invalidity of the kind we have been discussing would in general handicap its subject in competition with normal people. The result would be that, even supposing the first choice of occupation to be purely random, those who were weak in one way or another would be sifted out of the more secure positions, when their weakness was discovered, and would drift into whatever jobs they could get. Support for this idea is found in the fact that persons engaged in at least some of the occupations which appear low down in the lists enjoy as a rule a greater security of tenure and freedom of anxiety about the future (e.g. *Public administrators* and those in *Gas, water, and electricity* service), or they are better organized (e.g. *Miners*) than the majority. Also, there can be no question that the *General labourers* group, which is at the top of every list, contains a very large proportion of the flotsam and jetsam of the industrial world.

But, apart from this, the tables themselves do not suggest that skill or lack of skill, high wages or low, active or sedentary work, or any other single condition, is the determining factor in the positions taken by the different occupations, although each may have some influence upon the result. It is possible that those we look upon with pity, because they bear the stigma of poverty, or lunacy, or crime, are not after all made of very different clay from ourselves. More people than we imagine may be potentially subject to some form of instability, and the conditions in certain occupations may be such as to upset their balance in one direction or another more readily than would happen if they had been otherwise occupied. If this were so it should have the effect of making parents give more anxious consideration than they do to the choice of employment for their sons and daughters.

Mr. R. A. Fisher informs me that a quite extraordinary prevalence of crime and insanity has been found among the relatives of paupers in an East End Union, and he suggests that genetic causes of failure of all kinds may have become concentrated by selective marriage in certain stocks during a number of generations; but whether the association of such stocks with particular occupations is fortuitous

or dependent upon peculiarities in the recruitment or conditions of labour one cannot say.

Whatever the interpretation of the tables may be, it is sufficiently clear that, in attacking the problems of poverty, and mental deficiency and crime, we are attacking not three entirely independent problems, but three which are in some way closely related.

I should like to acknowledge the help I have received from Professor A. M. Carr-Saunders and Mr. Fisher in discussing with them the eugenic bearing of my results.

THE CONTRIBUTIONS OF ITALY TO MODERN STATISTICAL METHODS.*

By CORRADO GINI, Hon. F.S.S.

1. MEN are proverbially slow to appreciate the real bearing of the scientific and artistic achievements of their own day, even when these are their own.

Petrarch's fame rests on the sonnets which he looked on as idle toys, while the Latin poems from which he and his contemporaries anticipated glory are completely disregarded. The researches of Gregor Mendel, which have brought about a revolution in modern biology, did not make any great stir in his own time, and were indeed so largely forgotten that they had to be made anew and independently of their originator before they attracted the attention of the scientific world. No one—the discoverer perhaps less than any—foresaw that the absolute calculus of Professor Ricci Curbastro would be placed in the foreground of scientific research and would constitute the indispensable instrument of a new conception of the universe; and it is well known that Pacinotti attributed so little practical utility to the discovery of his ring, and Galileo Ferraris to that of his magnetic field (to which is due such a great part of the progress of modern electro-technique), that they did not trouble to take out any patents; and that Righi for years experimented on wireless telegraphy, without dreaming that by its means an undergraduate would ultimately put a network of communications round the globe.

It is therefore well to leave posterity to write the history of scientific research, even if, for certain branches such as Chemistry and Statistics, which have recently made the most progress, our contemporaries thereby lose the opportunity of observing an important stage of scientific development.

My lecture on Italian contributions to statistical methods is thus not intended to treat of the importance of the results obtained by individual statisticians, but rather to sketch the characteristics of modern Italian statistical science and the leading features of its researches.

2. One of the characteristics of Italian statistics is that most of

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its followers are, or desire to become, attached to Universities as professors or lecturers.

This is due to the remarkable prestige accorded to the university professor in Italy, as in Germany, and to the liberty of expressing his thoughts inside as well as outside the school—which he has enjoyed till lately, and which is not even now entirely abolished; it depends, too, upon the large number of University chairs at the disposal of statisticians.

Before Sr. Gentile's recent reform, all the seventeen Royal Universities of Italy, as well as the four free Universities, had the same courses, in which Statistics was an obligatory subject, as well as Economics and Finance, in the Faculty of Law. This Faculty is attended by a majority of students, as being the normal means of entrance to the legal profession and the civil service. The examination in Statistics was compulsory for the degree of doctor of law, and there might be a professor of the subject whenever the Faculty wished it. In the eight Colleges of Commerce, Statistics occupied a similar position; there was a two-years course, the first year being devoted to Statistical Methods and the second to Vital and Economic Statistics. Hence there were twenty-nine chairs of superior teaching which were open to professors of Statistics, and this was a sufficient outlet to ensure the placing of every young man who was devoting himself to our science with intelligence and steadiness.

The number of chairs of Statistics has increased lately as a result of the recent reform, as four new Universities and two new Colleges of Commerce have been established. Taking advantage of the autonomy of organization granted by the new act, several Faculties of Law have decided that the examination in Statistics is not to be obligatory but optional for their students, but on the other hand, beside the ancient Faculties, new Faculties or Schools of Political, or Economic, or Social Sciences have been founded, in which statistical teaching receives special attention, and where Vital or Economic Statistics or Biometry are added to the course on Statistical Methods. In some Universities, optional or obligatory courses in Statistics are also held for the students of the Faculties of Sciences and Medicine, and in Padua, according to my proposal, a special and autonomous School of Statistics was established, independent of any other Faculty, and authorized to grant a special certificate of proficiency in Statistical Sciences. I succeeded in having a similar certificate issued by the Institute of Statistics and Economics of the University of Rome, which is associated with the chair of the same title in the Faculty of Political Science.

As a result of this development, and, above all, because of the poorer preparation of the students during the war and post-war period, the present supply available on the scientific Italian market for the teaching of Statistics, as well as of many other sciences, is considerably below the demand of Universities and Colleges.

The existence of many chairs of Statistics has made a remarkable number of young scholars decide to devote themselves exclusively to this science, making the type of the pure statistician more frequent in Italy than elsewhere. By "pure statistician" I mean the scholar who makes Statistics and its applications the principal aim of his scientific activity, and does not study it merely as ancillary to researches in Economics, Finance, Anthropology, Psychology, or Medicine.

Another consequence of this specialization is that, in Italy, students of Statistics seldom limit their researches only to statistical methods or to their applications in one single field; generally each of them cultivates at the same time statistical methods and economic, financial, vital and social statistics, often also judicial statistics, less frequently anthropological and biological statistics, owing to the fact that this field has less direct contact with the economic and juridical matters taught in the Faculty of Law.

This characteristic of Italian statisticians is favoured by several circumstances. First of all, by the selection of the professors in Italian Universities, which is essentially on a competitive basis the choice being made by committees of professors, mostly belonging to the same branch of science. On these committees, elected once wholly, now mainly, by the members of the Faculties of Italian Universities having a chair of Statistics, the different scientific schools are generally represented, and the competitors are naturally inclined to win the favour of all their judges by showing aptitude in various fields. As a fact, other things being equal, variety of scientific production is often considered as giving preference in appointment to the chair. Many other circumstances are to be borne in mind. Many competitors during the period of their scientific preparation are employed in the statistical offices of the great cities or in the Central Bureau of Statistics, where they usually have the opportunity of dealing with varied statistics. This variety of statistical culture, on the other hand, is in accordance with the tradition of the best Italian statisticians brought up under the guidance of Bodio in the Central Bureau of Statistics, which became under his direction almost a scientific laboratory. It is made still easier by the classical training required of students of the Faculty of Law from

which most statistical scholars come. It appeals also to the humanistic taste of the Italian cultured class. A Superior Committee of Statistics is asked to give its advice on every research undertaken by the Central Bureau of Statistics, and eventually by the other Government Offices. It is composed, as to a large majority, of professors of Statistics, giving them the opportunity of applying their knowledge to the most varied subjects of statistical organization and observation.

Of course, I do not deny that the Italian statisticians, after having obtained their chairs, are inclined to specialize according to the field which they prefer; this happens as a rule, but their successive productions bear the effect of the former ample preparation and varied training. That helps to give a sure judgment on the practical bearing of theoretical methods, and to enable them to grasp the mutual affinities of statistical methods applied in different fields, and to gather sometimes new fruit in a new field by means successful in another. This special feature causes Italian statistics to present peculiar characteristics both in matter and manner.

3. Though several of the Italian statisticians come from Mathematics, I do not think that anybody attaches importance to the controversy whether Statistics should be treated as Mathematics or with Mathematics.

It is universally admitted that, in Statistics, Mathematics are to be considered as a means for presenting the subject in a more or less elegant form, but this merit must not let us lose sight of the fundamental truth that for Statistics they are no more than a means.

It is convenient also to add that, time and money being necessarily limited, it is better sometimes to avoid paying to the means an attention which postpones the attainment of the end, so that the saying that Statistics must be dealt with mathematically must not be accepted without qualification.

We must admit that, all statistical problems being problems in quantity, they may in theory be treated mathematically; and we must also admit that, if the subject lends itself to a theoretical solution, the solution obtained by Mathematics will be more rigorous and precise than any other. This does not mean, however, that it is always convenient to use this method; the statistical material at our disposal may be too rough to allow of the application of exquisite methods, or for the purpose of the research it may appear useless to seek precision beyond a certain limit. Moreover, we must not forget that time and work used in the theoretical elaboration of methods which may prove inapplicable or useless might often be employed to gather and transform new data, either widening the field of the research or increasing its depth. When,

for instance, I read the treatise of Knibbs on the theory of population, I admire it as a model of the systematic mathematical treatment of statistical problems, so great are the variety, elegance and simplicity of the methods employed, the resources used to surmount difficulties and the keen sense of sufficient approximation; but when I stop to consider the results obtained (some of them are very important indeed), and I ask myself how great a part is due to the refined methods described, I come to the conclusion that this part is very small, perhaps is non-existent; and I ask myself if, from the point of view of the study of population, it would not have been more useful, rather than spending much time on methods without practical bearing, to increase the number, sometimes too limited, of observations, to compare more often the results obtained for Australia with those of other countries, and to submit the data to more detailed tabulation.

In my opinion—and I think I can be allowed to say in the opinion of most Italian statisticians—this is not the most fruitful way for a statistician to employ Mathematics. His motto, instead of being represented by the words “Statistics with Mathematics,” should be represented by “Statistics with the least mathematical means possible.”

I mean to say that there are wide fields in which, either because of the primitive nature of the data at our disposal, or because the mass of gathered data practically excludes the influences of chance, or because our interest is concentrated on the actual facts independently of the causes more or less systematic or accidental which produced them, the statistical analysis does not need any instruments of calculation higher than simple arithmetic, and where it would be not only useless but harmful to have recourse to refined mathematical methods which, while they would not increase appreciably the fruitfulness of the research, would reduce the number of readers.

From these, one passes by degrees to higher fields in which the most perfect instruments of mathematical analysis must be used, either owing to the nature of the research, or because of the extreme exactitude required for the results, or because of large chance fluctuations due to the limited number of observations which cannot be amplified, or owing to the difficulty of distinguishing from the accidental influences the systematic factors that we want to bring out.

But in this case, too, it is important to bear in mind that, if Mathematics represent a necessary instrument, they are not, however, sufficient to ensure success, which above all depends upon a kind of statistical intuition helped by wide experience for which it would be useless to give fixed rules. It is this intuition and this knowledge which make the good statistician select the right way among

thousands of possible ways, the way which will lead him to the most fruitful result.

The higher one goes from the simpler phenomena of the inorganic world to those more complex belonging to Biology, to those still more intricate of social life, and from among these at last to the most complex which form the object of Statistics, the more that hidden work grows in importance. Upon it the soundness of the whole building depends. Just as the work and time required by the foundations compared to that necessary for the upper part of a building increases with its height, so there are no foundations needed for tents and the simpler huts, whilst they require the same amount of time and work as the whole superstructure in the case of the skyscrapers of New York. Already in the most difficult applications of the biological sciences, as in Medicine, and in the higher manifestations of art, success depends more on certain synthetic aptitudes, which are usually called "the clinical instinct" and the "artistic *flair*," than on following fixed rules. In the same way the success of the statistician depends essentially on that intuition which, with or without any knowledge of Mathematics, enabled Quetelet and Galton, and before them Graunt and Süssmilch, to enrich our science with new chapters.

This special feature of Italian statistics, though not leading the statisticians to despise mathematical technique, has led them to appreciate in an increasing measure in these last years that statistical intuition which is stimulated by knowledge of different scientific fields. This feature has reacted not only on the question of methods, but also, and perhaps more, on the subjects dealt with.

4. If we examine the way in which a science is founded and grows, we find that it is similar to the foundation and development of a large town. At first isolated groups of houses spring up at the points more convenient for production or exchange with the neighbouring country; whilst they grow, new intermediate ones become gradually inhabited, and these later on add themselves to the first ones, and in all of them works of adaptation and co-ordination take place at last, which give to the town the appearance of an organic unit with its own morphological characteristics and functions. But the first zone of the town is scarcely built when new groups of houses spring up, and these in their turn expand, and then connect with one another, and at last a second zone of the territory takes the shape of a town, sometimes determining modifications in the older zone. Meanwhile, farther on, the elements for a further extension are developing.

The field in which traditional statistics were developed, with the

theories of averages and of statistical ratios and the application of both to the tables of mortality and survival, had just received organic systematization in the first treatises of statistics when, outside of the ancient boundary, new fields were cultivated. Quetelet enriched statistical theory with the chapter on statistical distribution and indices of variability; Galton with the lines of regression and indices of correlation; Lexis added his theory of dispersion; from the physical sciences were imported the methods of smoothing and interpolation; meanwhile the methods of standard population and of index-numbers developed. They were, however, single chapters, and as a matter of fact the modern treatises, which, showing a decisive advance on the older, include these new chapters in their plan, often resemble a collection of interesting monographs rather than an organic exposition of an independent branch of science.

The special character of Italian statistics naturally led its students to find out what was fragmentary in that treatment and what was left undone from the standpoint of the exploitation of new fields and from that of the extension, adaptation, and co-ordination of the results already attained.

5. New and attractive zones were indeed waiting to be exploited. Variability was not the only aspect from which the distribution of one quantitative character could be studied; and similarly correlation was not the only aspect from which the distribution of two or more characters could be examined. The statistician is daily faced with problems more or less different.

The measure of variability based on the deviations of the particular cases from an intermediate modality is appropriate to anthropological and generally to biological characters where the distribution is frequently symmetrical or, if asymmetrical, condensed around the intermediate modalities. This method was not, however, equally appropriate to economic and financial characters. For these characters we usually speak of concentration; it is the measure and the graphic representation of this concentration that is required. The construction and the analysis of the *curves of concentration* of the characters and the introduction of *indices of concentration*, some of them (as the concentration ratio) applicable to every category of quantitative characters, some others, with which we will deal later on, adapted only to characters which follow a peculiar curve of distribution—has originated a new chapter of statistical theory, capable, in my opinion, of further developments. (1.) With these indices the measure of concentration of properties, incomes, inheritances, house rents, bank deposits, population, and scientific productivity was obtained, and more specially that of incomes

distinguished according to source, place of residence or profession of the taxpayer, and for several countries and several periods; so that it was possible to ascertain the great diversity of the concentration of wealth in different countries and the tendency of our times to a greater concentration of wealth and of income from property. We obtained also the measure of the concentration of prolificacy of marriages, illustrating its uniformity in time and place, in town and country, in different social classes, and fixing the part of the inequality in the distribution of wealth which might be attributed to different sizes of family. Comparison with similar indices determined for anthropological characters made it possible to draw up a kind of scale for the variability of human characters. (2.)

When we are faced with several statistical distributions, the first problem which arises is to measure their diversity. The *indices of dissimilarity* serve this purpose. (3.) They make it possible for us to judge how much the distribution of certain characters, such as stature, differ, for instance, between the different countries, and they constitute therefore a basis for measuring the influence of the countries on the distribution of the above characters by methods with which we will deal later on.

Another problem is to determine how to pass from one distribution to another, by means of a formula which expresses the members of one distribution as functions of the corresponding members, called *cograduates*, of the other distribution. (4.)

Such a study of the *relations between the cograduate quantities* was sometimes confused with the relations between associated quantities as we find it in the traditional chapter of correlations—whereas it should be kept strictly apart. For instance, correlation expresses the relation which exists between the income and property of the same person; the relation between cograduate quantities expresses the relation which exists between income and property, which occupy the same place in the corresponding scale. It is the latter and not the former that would be used by the Treasury, which would calculate from a known distribution of incomes the corresponding unknown distribution of property. Correlation expresses the relation which exists between stature and the dimensions of the head in the same individual; the relation between cograduate quantities expresses the relation which exists between the stature of the giant and the head of the macrocephalus, between the average stature and the normal head, between the stature of the pygmy and the head of the microcephalus. The second method, and not the first, may indicate, for instance, if the head is more or less variable than the stature between different individuals: Quetelet, who used the first method,

came to the erroneous conclusion that the head is distinctly less variable.

The means of the deviations constitute a convenient measure of the degree of precision of the average of the single character, giving us an idea of the probable error involved when we pass from one term of the series to the average; but it was necessary to find out a new method in order to measure the uncertainty with which we can pass from the relation between two averages to the relations between the terms of the corresponding series. The average man is taller than the average woman, but that is not always true for every man and woman taken separately. This applies to many characters, when we compare the two sexes, or two varieties of the same species, or two different species. This phenomenon is known in biology under the name of *transgressive variation* or *transvariation*, because, representing by a diagram the two distributions, their curves cross each other at least in one point. It is important to give their measures in order to determine the reliability which we can attribute to the character for the purpose of identifying the sexes or the varieties or the species. The *indices of transvariation* answer this question. (5.) They are being intensively used at present—and some applications have already been published—precisely in order to measure the regularity of the differences that man and woman present with respect to secondary sexual characters. (6.)

6. Many other researches of Italian statisticians aimed at adapting methods imported from other sciences to the purpose which they must fulfil in the field of statistical phenomena.

As we have seen, statisticians had already taken from the physical and astronomical sciences the concept of deviations from an average in order to measure the variability of the characters. The method answers well when the average represents a really existing objective value, from which the measurements furnished by observation diverge owing to accidental errors, or at least when it represents a typical value, as in the Gaussian distribution. But in many other cases, as in the series of the prices of a commodity at different times or in different places, the average from which the deviations are taken has not such a meaning, and the problem of the measurement of variability does not consist therefore in determining how much the different measurements differ from an average, but how much the different magnitudes differ among themselves. Therefore, the notion of *mean of all possible differences* was introduced and has already been used by several authors in the field of economic and demographic phenomena. (7.)

Likewise, it is to work in the field of the errors of observation

by Bravais that the notion of correlation has been traced. But the well-known researches of Pearson and Yule have adapted the notion to the practical requirements of the variety of cases which occur in statistics, demonstrating the validity of the coefficient of correlation for all linear relations and then introducing the method of the correlation ratio for non-linear relations.

But, even if we consider only the field of quantitative characters, statistical relations are too numerous and varied to be described by these indexes only. First of all it is necessary to distinguish two categories of relations. Having two associated characters, we can ask ourselves if the distribution of a character is influenced by the presence of one rather than another modality of the second character; for instance, if the distribution according to age of the bridegroom is influenced by the circumstance that he exercises one or another profession. It is possible that in different professions the average age of the bridegroom differs; this influence will be revealed by the correlation ratio; but it is also possible that the distribution by age is very different in different professions although the average ages are approximately the same. In order to measure all relations of this type, it seemed advantageous to introduce *indices of connection*, of which the correlation ratio constitutes a particular case. They are based on the indices of dissimilarity of which we have already spoken, and are not bound to a special form of the surface of distribution.

In many researches, after having stated that there is a connection between two characters, we can pass to examine other features. It is necessary for this purpose that the modalities of one character be comparable with those of the other; for instance, we might enquire if there is *concordance* or *discordance* between variations of stature and of cephalic index, but we cannot thus compare variations of stature and of profession, because there is no modality of professions which might be considered as concordant with great stature rather than with small stature. (8.) The measure of concordance appears then as a research quite different from, and subordinate to, that of connection. A special category of indices corresponds to it. The well-known coefficient of correlation occurs as a special case of this category. (9.)

Indices of connection and indices of concordance can be established not only between the relative deviations (i.e. the ratios of absolute deviations to their mean), as is the case in the coefficient of correlation, but also between the absolute deviations or between the modalities. In measuring the relation between the stature of a mother and the stature of a new-born baby, we must evidently

eliminate the influence of age upon stature, as well as the influence of the different intensity of the deviations due to the different heights, the deviation of an inch having evidently a different meaning for a baby and for a grown-up person. In this case we shall be justified in measuring the connection or the concordance between the relative deviations. But we may want to measure the resemblance of the cephalic index between the father and the grown-up son, in order to decide if and to what extent the cephalic index changes from one generation to another (the problem is not an imaginary one, but was treated by Boas with reference to the sons of different European races who emigrated into the United States). In this case, it would be proper to take into account, not only the differences due to the lack of correspondence in the relative deviations, but also those due to the different intensities of the deviations and to the differences of the means. We should therefore measure the relation between the values of the cephalic index and not that between the relative deviations. Similarly, studying the relation between two series of index-numbers, it is the relation between their values, and not between their relative deviations, which is of interest. In other cases (as in the measure of the relation between the age of bride and bridegroom) it may be useful for the purpose of the research to eliminate the differences of the means, but not the differences of the intensity of deviations, and to establish therefore the index of concordance between the absolute deviations.

Another distinction depends on the limit that we take as the maximum of the connection or of the concordance. If in a dancing-hall there are many fair men and a few dark ones, and on the contrary many dark girls and a few fair ones, and if all of them dance, necessarily only in a few cases will both partners be dark or fair. If these cases are as numerous as possible, ought we to say that the maximum of concordance is attained? or, on the contrary, ought we to say that the said maximum would be attained only in the impossible case that in all the couples the man and the girl were both fair or both dark? The same problem arises in each measurement of concordance, when the two characters under examination have not the same distribution, and in many measurements of connection. Hence the necessity of distinguishing an *absolute maximum* of the connection or concordance from a *relative maximum*, and of establishing indices in accordance with the two hypotheses. In the coefficient of correlation, for instance, we take as the maximum of the correlation the absolute maximum, and therefore the coefficient cannot be equal to the unit when the two correlated characters have different distributions. (10.)

One might observe on this point that these considerations lead to a complicated system of indices, and this cannot be denied ; but the complication exists in the varied and manifold nature of the relations between collective phenomena ; the statistician has no other purpose than to prepare the instruments best suited for each of them. In my opinion, he would be seriously mistaken if he pretended to constrain the multiform reality to lie on the Procustean bed of one or of a few indices, because of the ease with which they are calculated or of their analytical properties. (11.)

The indices of variability and of correlation have a general validity for all series, whatever be their form, as average measures of certain aspects of collective phenomena ; but some of them, such as mean deviation and coefficient of correlation, have, in the particular case of Gaussian distributions or surfaces, a special value, we might say a descriptive value, as they are apt to determine the frequency of different values of one variable corresponding to each value of the other variable or to each combination of values of the other variables, and make it possible therefore to describe the frequency distribution of a character or the surface of correlation of two or more characters.

It was, however, important to establish indices having a descriptive value also for distributions quite different from the Gaussian ones. This purpose is attained by *special indices of concentration* which describe the curves of concentration of total incomes and rents, of the number of children, of the number of inhabitants of the towns, and of the scientific productivity, and by *special indices of dependence* which describe the relations existing between income and rent, income and property, the amount of an inheritance and the number of the heirs and legatees, the age of the mother or father, or the duration of the marriage, and the prolificacy or fecundity of the married couple. (12.)

7. The *theory of dispersion* has represented a fortunate adaptation of the results of the calculus of probability in the field of statistics intended to verify whether facts occur as they should if the hypothesis on which the theory of probability is based answered to reality. Such hypotheses are, as is known, the constancy of probability in time and the independence of the probabilities of different events. But it is possible that each hypothesis diverges in fact from reality in opposite directions, so as to compensate each other. In order to make the enquiry as profitable as possible, it is therefore advisable to analyse the facts so as to determine whether the hypotheses are verified. Such a research made into sex ratio at birth enabled us to disregard the numerous theories which attributed to

variations of economic and climatic conditions an influence on the sex of the infant. (13.)

A conception similar to that applied by the theory of dispersion may be usefully applied to probabilities *a posteriori*. The famous theorem of Bayes was claimed to give a means of foretelling from the past frequency of an event its future frequency, and was based on the idea—rightly criticized—that if we are ignorant of the exact probability which governs the happening of the event, it might be admitted *a priori* that all hypotheses were equally possible. But we may notice that in several cases past experience does show us the frequency with which the different hypotheses are realized. For instance, statistics tell us the frequency with which families of four children have four boys, or three boys and a girl, or two boys and two girls; so that, when the first two children have been two boys, we can determine, granting the validity of the two hypotheses on which the theory of probability is based, the chances of having in the two successive births two more boys, or one boy and one girl, or two girls. The comparisons of the chances so determined with the actual happenings will enable us to decide whether these hypotheses are justified. By this means it was possible to ascertain that in individual families there is sometimes a tendency to procreate boys only, or girls only, but this tendency, in one case as in the other, diminishes with time and often is followed by an opposite tendency. (14.)

8. In the field of interpolation of statistical series it is necessary, as is well known, to bear in mind many considerations in order to choose the best method either for describing the trend of the series with the greatest exactitude compatible with the data of the problem, or instead to smooth the observed quantities, eliminating the effect of the fluctuations which can be attributed to perturbing factors. (15.) And we ought to take account not only of the perturbing factors which influence the values of the function, as one does with the method generally used, but also of those which influence the values of the variable taken as independent. (16.)

But when the purpose of the interpolation is either that of filling the gaps of a series of quantities, or of foreseeing, through extrapolation, the development of the phenomenon beyond the limits of observation, the determination of the best method has—we can say—still to be made. I say it has still to be made, because what has been accomplished in Italy is but a first essay. As a matter of fact, this is a question which must be solved experimentally through long and tedious researches. Many statisticians seem to admit implicitly that the methods of interpolation which give the best results in

describing or smoothing a series, answer also better the purpose of inserting the missing terms or of foreseeing future observations. But as a matter of fact, there is not any general reasoning which can justify such a point of view. For instance, it is well known that a series of terms is described by a curve of a given type all the more faithfully the greater the number of its parameters. But this does not mean that one curve with a greater number of parameters extrapolates better values beyond the limits of observation, or that using it in inserting the missing terms of a series we obtain results more approximate to reality. In the researches made up to the present, relating to the international commerce of Italy, Spain, and Germany, the results obtained have led to a contrary conclusion. Each term of each series (the first and last five excluded) was, one after another supposed unknown and interpolated by the formula of Lagrange utilizing successively two, four, six, eight, and ten symmetrical terms. This was equivalent to interpolating the term supposed unknown by a straight line or respectively by a parabola of the third, fifth, seventh, and ninth degree. Now the terms obtained by the interpolation of a straight line were, from every point of view, better approximations to the real terms supposed unknown, and the approximations were less and less accurate as one passed to the formulæ of higher degree. Similarly we might enquire if the anticipation of the future development of a phenomenon proves to be better if made by a straight line based on the two last terms, or by a parabola of the second degree based on the three last terms, or by a parabola of a higher degree based on a greater number of terms. (17.)

I think it is useless to insist on the practical importance which the problem may assume when it becomes advisable to express quantitatively those anticipations of the movements of economic indices, with which are associated in England the well-known names of Beveridge and Bowley. (18.)

Another noteworthy source of statistical research in Italy was the extension of proposed methods to neighbouring fields.

The modern methods of statistical elaboration were originally established in order to be applied to the quantitative measurements of characters. But already Galton and Pearson extended their applications to those characters which are not quantitatively measurable and therefore are generally expressed by qualitative expressions (for instance, beautiful, fine, pretty, ugly, very ugly). And, again, Pearson and Yule in England and some Italian and German writers extended their application to the modalities of attributes of some qualitative characters. (19.)

But the subject deserved a more analytical study, and first of all a *rational distinction of the principal types of qualitative characters*.

There are some qualitative characters whose modalities present a natural order of succession, as the ranks of the army or the days of the week. The respective series—for instance, the series of the number of weddings in the different days of the week, or that of the number of the soldiers in the different grades of the army—are called *ordered*, against the series so called *not ordered*, as for example that of the inhabitants of a country classified according to religions or professions, for which it is not possible to determine a similar order for all the modalities. Further, in the categories of the ordered series it is necessary to distinguish two types, the first one in which there are two modalities which ought to be considered as extremes, as in the case of the ranks of the army, and the second in which we can consider each modality indifferently, except for a convention, as to the first or as to the last, as in the case of the days of the week, or the months of the year, or the directions of the wind. In the first case, the series are called *rectilinear*, in the second *cyclical*.

The non-ordered series offer many varieties, because often, if all modalities do not present a natural order of sequence, some of them, more or less numerous, present it, but for our purpose it is convenient to consider the extreme type, in which the difference is the same between any two modalities. This theoretical type of series, called *unconnected* series, is hardly realized, but there are several series, *e.g.* those of the population classified by religions, professions, races, which can be treated, by approximation, according to that type.

Now in order to extend to the ordered, cyclical, and unconnected series, the methods of the mean difference and of the indices of dissimilarity, of connection and of concordance, it is sufficient to have a measure of the differences between the modalities of the character. For the unconnected series it is immaterial whether we adopt one measure or another, because the difference is, by definition, constant between any two modalities, and the simplest thing is to adopt the unit as a measure. For the rectilinear or cyclical series, different expedients, according to the case, can be of help: for instance, in the case of a scale of employees, the difference between two degrees can be measured by the difference between their average and initial salaries; in the case of the days of the week their difference is given by the interval between the beginning of the one and the beginning of the other, agreeing to count the distance in the shorter direction.

If we have such a measure, the treatment of rectilinear series

becomes then quite similar to that of quantitative characters, whilst the treatment of cyclical and unconnected series demands special proceedings, which have been studied and applied. (20.)

So, starting from uniform principles, it has been possible to measure the heterogeneity of countries according to nationality, language, religion, agriculture, the variability of weddings according to the day of the week or the month of the year, the variability of births and of deaths according to the months of the year, the variability of the winds according to their direction, the concordance between the month of birth of the mother and that of each child, and that between the race, nationality, birthplace, religion, etc., of the bride and the bridegroom, and the connection in Italy between the direction of winds and the different regions. (21.)

At first sight it seems inconceivable to speak of a mean and, consequently, of the deviations from the mean for cyclical and unconnected series, because in these there are no extreme modalities and the definition of the mean implies the existence of two extreme modalities between which the mean is included. But there are means the definition of which can be extended so as to be applied also to such series. So the arithmetic mean can be defined as the modality which has the property of making a minimum the sum of the squares of the deviations from it, and this definition can be applied also to the cyclical and unconnected series. To these series the conception of value of greatest frequency or mode can also be applied, and from the arithmetic mean or from the mode it is possible to determine the deviations and calculate their mean.

Further, it is possible to extend the definition of deviation in such a way as to make it independent of the mean and to apply it therefore also to cyclical and unconnected series. The conception of mean deviation, so extended, measures the mean asymmetry, which the system of different modalities represents with reference to the single modalities. This aspect of the collective phenomena coincides with the aspect of variability for the series of quantitative characters and for rectilineal and unconnected series, but it differs from this for cyclical series, as has been illustrated by applications to the series of weddings, of births, and of deaths according to the days of the week, or to the months of the year. (22.)

8. Other researches have been made in Italy with a view to connecting the methods established in different fields, which, when carefully analysed, revealed mutual relations at first unlooked for.

For instance, it was possible to ascertain that the mean difference coincides practically with the concentration-ratio, and that the curves of concentration furnish the graphic representation of the

mean difference as well as that of the mean deviation from the arithmetic average or from the median. (23.) The theory of dispersion can be included as a particular case in the theory of connection. (24.) The method of index-numbers is closely related to and sometimes identical with the method of standard population; and many other problems which we face in different fields of statistics can be reduced to applications of this method. (25.)

9. As we have said. Italian professors of statistics are frequently in touch with the statistical bureaux, and this induces them to study those branches of statistics, such as the collection, classification, criticism and interpretation of data, which in some other countries are so little considered by modern statisticians, that they are not even mentioned in their treatises. As a matter of fact, these branches of statistics deal with rules generally simple and almost obvious, so that their treatment may seem superfluous, but they may involve some questions, the treatment of which requires an ingenious application of refined methods. This is the case, for instance, for such indirect observations and conjectural statistics as include the majority of methods for estimating wealth, a subject which in Italy has been fully treated. (26.) A similar remark applies to the well-known *representative method* to which some eminent statisticians in many countries have recently paid attention. (27.) Such is also the case of the logical interpretation of the formulæ which describe statistical distributions (28) and of methods of experimental induction, the application of which to collective phenomena requires special qualifications. (29.)

So in some recent Italian courses or treatises on statistics, which take due note of all these various researches, we can see the framework of an organic and complete treatment of statistical science. (30.)

10. Many researches which I have mentioned are only sketched; few, perhaps none, have reached the perfection attained by the English school in the fields of frequency curves and of coefficients of correlation.

Instead of contributing to the further perfecting of existing methods, Italian statisticians have preferred to direct their main efforts to enlarging the boundaries of Statistics, building the new roads required in order to connect the sundry aspects of the collective phenomena. This does not prevent them from looking with admiration on the soundness and beauty of the building which constitutes the first centre of the scientific construction of our science, and which still represents its most perfect example; but it allows them also to consider with satisfaction their own work done for the integration and co-ordination of statistical science.

BIBLIOGRAPHICAL NOTES.

(1.) "Il diverso accrescimento delle classi sociali e la concentrazione della ricchezza," *Giornale degli Economisti*, Jan., 1909: "Indici di concentrazione e di dipendenza," *Biblioteca dell' Economista*, vol. xv: Torino, Unione Tipografico-editrice Torinese, 1910: "Variabilità e Mutabilità," *Studi Economico-giuridici della R. Università di Cagliari*, 1912: "Sulla misura della concentrazione e della variabilità dei caratteri," *Atti del R. Istituto Veneto di Scienze, Lettere ed Arti*, 1913-14, t. lxxiii, part ii, pp. 1203-1248; and also F. Savorgnan, "Intorno all'approssimazione di alcuni indici della distribuzione dei redditi," *Atti del R. Istituto Veneto di Scienze, Lettere ed Arti*, t. lxxiv, part ii, p. 755 et seq., p. 793 et seq.; U. Ricci, "L' indice di variabilità e la curva dei redditi," *Giornale degli Economisti*, Sept., 1917 (and, on Ricci's article, the note of G. Pietra, "Recenti pubblicazioni di metodologia statistica," *Rivista Italiana di Sociologia*, Mar.-June, 1917, Rome); L. Amoroso, "Ricerche intorno alla curva dei redditi," *Annali di matematica pura ed applicata*, series iv, t. ii, 1924-5: "Intorno alla curva dei redditi," *Il giornale Economico*, Aug. 10, 1924; G. Di Roco, "Applicazione dei metodi statistici all' idrologia": Consiglio Internazionale di ricerche, Unione internazionale di Geodetica e Geofisica, Venice, Feb., 1924. Some foreign authors have also treated the subject either incidentally or specifically.

Several of the above-quoted works and papers examine the relations of the indices of concentration with Lorenz's curve of concentration and with Pareto's index of distribution of incomes, proposed in *Cours d'économie politique* (Lausanne, Rouge, 1897), book iii, chap. i, and then largely applied in Italy, especially by R. Benini, C. Bresciani Taroni, F. Corridore, E. Porru and F. Savorgnan. The problems of the theory of concentration are closely examined in a work in the press which collects and comments on the author's papers on statistical methods—*Memorie di metodologia Statistica*, Biblioteca del Metron, R. University of Padua.

(2.) The bibliography of the works which contain applications of the indices of concentration is too long to be given here. It will be found in the above-mentioned work (in the press), *Memorie di metodologia Statistica*.

(3.) Cf. "Di una misura della dissomiglianza tra due gruppi di quantità e delle sue applicazioni allo studio delle relazioni statistiche," *Atti del R. Istituto Veneto di Scienze, Lettere ed Arti*, t. lxxiv, part ii, 1914. A similar method was proposed some years after by F. Boas, "The measurement of differences between variable quantities," American Statistical Association, Dec., 1922. G. Pietra ("The theory of statistical relations with special reference to cyclical series," *Metron*, i-vii, 1925, vol. iv, Nos. 3, 4) discussed Boas's method (p. 388, note) and made a number of applications of the simple and quadratic indices of dissimilarity, using arithmetical as well as graphical methods of calculation (pp. 389-402).

(4.) See, for the treatment of this problem, the paper "Delle relazioni tra le intensità cogradsate di due caratteri," *Atti del R. Istituto Veneto di Scienze, Lettere ed Arti*, t. lxxvi, part ii, 1917. The notion of *cogradsated quantities* was introduced some years before in the above-quoted paper "Di una misura della dissomiglianza" (p. 192).

(5.) Cf. "Il concetto di transvariazione e le sue prime applicazioni," *Giornale degli Economisti*, Jan., 1916.

(6.) See M. Boldrini, "Su alcune differenze sessuali secondarie nelle dimensioni del corpo umano alla nascita e nelle età superiori," *Archivio per l'Antropologia e la Etnologia*, 1919; "I cadaveri degli sconosciuti, Ricerche demografiche ed antropologiche, sul materiale della 'Morgue' di Roma," *La Scuola positiva*, 1920; "Differenze sessuali nel peso del corpo e degli organi umani," *Rendiconti della R. Acc. Naz. dei Lincei, Classe di Scienze fisiche, mat. e nat.*, 1920 (three notes); "Misure interne ed esterne di alcune ossa lunghe nell' uomo e nella donna," *ibid.*, 1924; "Gli studi statistici sul sesso. La proporzione dei sessi nelle nascite e i caratteri sessuali secondari," *Rassegna di studi sessuali*, 1921;

Biometrica, "Problemi della vita delle specie e degli individui" (Padua (C.E.D.A.M., 1926), chap. vi.

(7.) The mean of all possible differences, named *mean difference*, was proposed as a measure of variability in the above-quoted work, "Variabilità e Mutabilità" (1920). A list of the principal authors who have since described and applied this method will be found in the work *Memorie di metodologia Statistica*. Whether we take as a basis in measuring variability the deviations from the average, or whether we take as a basis the differences between the terms, the question arises whether we should consider the absolute value of the average of these deviations or differences, or its relative value obtained by comparing the average deviation or the average difference with the average intensity of the character or one of its functions, as, for instance, the square root of the average intensity. (Cf., on this subject, "Sulla Variabilità dei due sessi alla nascita e nelle età adulte," *Studi Economico-giuridici della R. Università di Cagliari*, 1916, "Variabilità e Mutabilità, secs. 56-61.

(8.) For the distinction between connection and concordance, and for the indices of connection, see "Di una misura della dissomiglianza," above quoted, p. 185 *et seq.*; "Nuovi contributi alla teoria sulle relazioni statistiche," *Atti del R. Istituto Veneto di Scienze, Lettere ed Arti*, 1914-15, t. lxxiv, part ii, p. 1904 *et seq.*; "Sul criterio di concordanza tra due caratteri," *ibid.*, t. lxxv, part ii, p. 309 *et seq.*

(9.) For the principles on which the measurement of concordance may be based, see the above-quoted paper "Sul criterio di concordanza." The various indices of concordance are dealt with in the papers "Indici di omofilia e di rassomiglianza e loro relazioni col coefficiente di correlazione e con gli indici di attrazione," *Atti del R. Istituto Veneto di Scienze, Lettere ed Arti*, 1914-15, t. lxxiv, part ii, p. 583 *et seq.*; "Nuovi contributi," *ibid.*, quoted above; "Indici di concordanza," *ibid.*, 1915-16, t. lxxv, part ii, p. 1419 *et seq.*

(10.) See, on these distinctions, more especially the above-quoted papers "Indici di omofilia e di rassomiglianza": "Nuovi contributi"; "Indici di concordanza." The index of rank-correlation is also considered as the measure of a special aspect of concordance and not as a simple method of determining the value of the coefficient of correlation. Cf. the note *Di una misura delle relazioni tra le graduatorie di due caratteri*, published as an appendix to a study by A. Mancini, on *Le elezioni politiche del 1913 nel Comune di Roma* (Rome, Cecchini, 1914), and secs. 17 and 18 of the above-quoted paper "Indici di concordanza." In the note to pp. 1456, 1457 of the latter paper, the relation is considered between my formula for the index of rank-correlation and the formulae proposed by Spearman and Pearson. Some methodological considerations on the index of rank-correlation are due to F. Savorgnan ("Sulla formazione dei valori dell'indice di cograduazione," *Studi Economico-giuridici della R. Università di Cagliari*, 1915, part ii, Cagliari, 1916). A generalization of the relations between series of values is represented by the *relations between series of groups*. See, on this subject, G. Pietra, "The theory of statistical relations," above quoted, pp. 444, 445.

(11.) Appropriate applications of the majority of the indices of concordance and connection have been made by G. Pietra in the above-quoted paper "The theory of statistical relations." F. Savorgnan made applications to the resemblance of bride and bridegroom in several papers collected in the volume "La scelta matrimoniale," *Biblioteca del Metron*, Padova, 1924; and F. Vinci made some applications to the concordances between the index-numbers of different commodities and between the net and the total productivity of marriages ("Sulla misura della concordanza tra caratteri quantitativi" (Rome, Athenæum, 1918)). The applications of my formula of the index of rank-correlation are too copious to be fully quoted: a bibliography up to the beginning of 1916 can be found in the paper "Indici di concordanza," p. 1455. Among later applications, those by Prof. G. Zingali and Dr. V. Castrilli are especially interesting (cf. Zingali, "Della misura statistica dell'abilità dei giocatori nelle corse al galoppo," *Metron*, vol. I, No. 1, i + vii, 1920; Castrilli,

"Gli studenti delle Università Italiane. Indagini statistiche," *Bollettino Ufficiale del Ministero dell'Istruzione Pubblica, Supplemento al No. 59 del 31 dicembre 1923*, pp. 135, 150 et seq.

(12.) See the above-quoted works: "Il diverso accrescimento delle classi sociali," secs. xv-xxi; "Indici di concentrazione e di dipendenza" and "Variabilità e Mutabilità," secs. 39-44.

(13.) See *Il sesso dal punto di vista statistico* (Palermo, Sandron, 1908), chap. v.

(14.) See "Considerazioni sulle probabilità a posteriori ed applicazioni al rapporto dei sessi nelle nascite umane," *Studi Economico-giuridici della R. Università di Cagliari*, anno iii, 1911. Some of the observations contained in the article "Sulle vaccinazioni antitifiche nell'esercito Italiano durante la guerra," *Metron*, vol. iii, Nos. 3, 4, 1926, refer to a field of inquiry related to that of probabilities *a posteriori*—that is, the inverse theorem of Bernoulli and its use in determining the probability that the difference between two frequencies be significant.

(15.) See "Considerazioni sull'interpolazione e la perequazione di serie statistiche," *Metron*, vol. i, No. 3, 1921. "On the technique of the interpolation of statistical series, special mention must be made of the contributions by V. Pareto, 'Quelques exemples d'application des méthodes d'interpolation à la statistique,' *Journal de la Société de Statistique de Paris*, Nov., 1897; 'Tables pour faciliter l'application de la méthode des moindres carrés,' *Assemblée annuelle des statisticiens officiels de la Société Suisse de Statistique*, 1898 (Lausanne): 'L'interpolazione per la ricerca delle leggi economiche,' *Giornale degli Economisti*, May, 1907, and June, 1908; and by F. P. Cantelli, *Sull'adattamento delle curve ad una serie di misure o di osservazioni*, Rome, 1905.

(16.) The problem was treated in Italy in some articles in *Metron*. See "L'interpolazione di una retta quando i valori della variabile indipendente sono affetti da errori accidentali" (vol. i, No. 3, 1921); G. Pietra, "Interpolating plane curves" (vol. ii, Nos. 3, 4, 1924).

(17.) See "Ricerche sperimentali nel campo dell'interpolazione di serie statistiche," *Atti del R. Istituto Veneto di Scienze, Lettere ed Arti*, 1922-3, t. lxxii, part ii.

(18.) Italian authors have also made contributions in the field of graphic representation of statistical phenomena, adapting to it the methods used in other fields of science or proposing new ones. Notable studies are those by L. Perozzo, on the curve di livello and on the stereogrammi (cf. "Stereogrammi demografici," *Annali di Statistica*, serie 2, vol. 22, 1881); "Nuove applicazioni del calcolo delle probabilità allo studio dei fenomeni statistici e distribuzione dei medesimi secondo l'età degli sposi, *ibid.*, series 3, vol. 5, 1883. Various systems of graphic representations *a congiungenti* are suggested in the "Appunti di Statistica," taken at my lectures given at the R. University of Padua, and published in several editions. Cf., in particular, the second edition, edited by E. Bittarello (*Anno accademico*, 1913-14; La Litotipo, Padova), and the third edition, edited by Prof. De Pietri Tonelli (*Anno accademico*, 1913-14; La Litotipo, Padova). General remarks on the advantages and drawbacks of graphic representations are found in the note: "Sull'utilità delle rappresentazioni grafiche," *Giornale degli Economisti*, 1914.

(19.) In Italy, Prof. R. Benini. Cf. *Principii di demografia*, Firenze, Barbera, 1901, pp. 129, 130.

(20.) See on this subject the above-quoted work, "Variabilità e Mutabilità," secs. 9, 65 and 90: "Indici di omofilia," sec. 8; "Di una estensione del concetto di scostamento medio e di alcune applicazioni alla misura della variabilità dei caratteri qualitativi," *Atti del R. Istituto Veneto di Scienze, Lettere ed Arti*, 1917-18, t. lxxvii, part ii; G. Pietra, "The theory of statistical relations, with special reference to cyclical series," above quoted.

(21.) See, for these and other applications, "Variabilità e Mutabilità," part 11; "Indici di mutabilità," sec. 64 *et seq.*; "Di una estensione del concetto di scostamento medio," etc.; F. Savorgnan, "La scelta matrimoniale"; G. Pietra, "The theory of statistical relations."

(22.) See the above-quoted paper, "Di una estensione dello scostamento medio."

(23.) See the above-quoted papers, "Sulla misura della concentrazione e sulla variabilità dei caratteri"; G. Pietra, "Delle relazioni tra gli indici di variabilità."

(24.) See G. Pietra, "The theory of statistical relations," Introduction, sec. v.

(25.) "Quelques considérations au sujet de la construction des nombres indices des prix et des questions analogues," *Metron*, vol. iv, No. 1, pp. 15 + vii, 1924.

(26.) A list of authors who treated the subject prior to 1913 may be found in the work *L'ammontare e la composizione della ricchezza delle nazioni* (Torino, Bocca, 1914). Since then several articles have completed the results obtained in this book from the theoretical standpoint or have brought them up to date. See "Sul presumibile ammontare dei danni di guerra," *Giornale degli Economisti*, Jan., 1919; "Sulle valutazioni della ricchezza nazionale," *ibid.*, July, 1919; "Qual' è l'indennità di guerra a cui l'Italia avrebbe diritto?" *Il Tempo*, Jan. 27 and Feb. 3 and 5, 1919; "La ricchezza dell'Italia," Supplement to *Economico del Tempo*, April 20, 1920 (these four articles are reprinted in the work *Problemi sociologici della guerra* (Zanichelli, Bologna, 1921)); "A quanto ammonta il reddito degli Italiani?" *Il Tempo Economico*, Jan. 6, 1921; "Sull'attuale ricchezza dell'Italia," *L'Economista d'Italia*, Dec. 3, 1922; "La guerra e la ricchezza nazionale," *Economia*, year ii, vol. iv; "La ricchezza comparata delle nazioni," *Nuova Antologia*, July 16, 1926; "A comparison of the wealth and national income of several important nations (Italy, France, Belgium, United Kingdom, United States) before and after the war" (Roma, Provveditorato Generale dello Stato, 1925). See also F. Benedetti, "La produzione della ricchezza privata Italiana prima della guerra, numericamente analizzata nella sua distribuzione," *Giornale dei lavori pubblici e delle strade ferrate*, 1916; L. Maroi, "Come si calcola e a quanto ammonta la ricchezza dell'Italia e delle altre principali nazioni," *Rivista delle Società Commerciali*, Oct. 31, 1918; F. Savorgnan, "L'ammontare e la composizione della ricchezza in Italia e nelle sue regioni," *Rivista Italiana di Sociologia*, May-Aug. 1916; "La ripartizione regionale della ricchezza privata italiana," *Metron*, vol. i, No. 3, i-iv, 1921; "La ricchezza della Nuova Italia," Supplemento economico del *Tempo*, May 5 and 20, 1919; J. Tivaroni, *L'imposta sulle successioni nella finanza contemporanea* (Turin, Unione Tipografico-editrice, 1916); G. Zingali, "Sull'ammontare della ricchezza privata in Sicilia," *Atti della Società Italiana per il progresso delle Scienze*, xii session; M. Balestrieri, "I consumi alimentari della popolazione Italiana dal 1910 al 1921," *Biblioteca del Metron*, 1925. Among the older works special mention should be made of those of L. Bodio, *Di alcuni indici misuratori del movimento economico in Italia*, 1921 (Rome, Bertero); M. Pantaleoni, "Dell'ammontare probabile della ricchezza privata in Italia," *Rassegna Italiana*, Rome, 1884; "Dell'ammontare probabile della ricchezza privata in Italia dal 1872 al 1889," *Giornale degli Economisti*, Aug., 1890; "Delle regioni d'Italia in ordine alla loro ricchezza e al loro carico tributario," *ibid.*, Jan., 1891; F. S. Nitti, *La ricchezza dell'Italia* (Napoli, Società Anonima Tipografica, 1904); F. Coletti, "La determinazione della durata della generazione e il calcolo della ricchezza privata di un paese," *Riforma Sociale*, 1907; C. Gini, "Il calcolo della ricchezza di un paese in base alle statistiche delle successioni e donazioni," *Atti dell'Ateneo di Treviso*, 1908; R. Benini, "Quote successorie di alcune specie di ricchezza," *Rendiconti della R. Accademia dei Lincei*, 1909; G. Mortara, "Intorno al calcolo della ricchezza privata dell'Italia," *Giornale degli Economisti*, 1909; L. Princivale, *La ricchezza privata in Italia* (Napoli, Cooperativa Tipografica, 1909).

(27.) See the reports presented by A. L. Bowley, A. Jensen, L. March, C. A. Verrijn Stuart, at the Sixteenth Session of the Intern. Inst. of Statistics, Rome, 1925. The attention of Italian statisticians was also directed to the methods for making representative collections of data which were not originally representative. See the above-quoted *Appunti di Statistica*, 3rd edition, by A. De Pietri-Tonelli, pp. 302-328.

(28.) See R. Benini, *Principii di Statistica metodologica*, Torino, 1906, pp. 295, 292, and the above-quoted *Appunti di Statistica*, 3rd edition, pp. 409-414, 628-631. For the special distribution of incomes, see the same works (Benini, pp. 307-310; *Appunti di Statistica*, pp. 632-633) and the articles: "Il diverso accrescimento delle classi sociali e la concentrazione della ricchezza," *Giornale degli Economisti*, Jan., 1919; F. P. Cantelli, "Sulle deduzioni di leggi di frequenza da considerazioni di probabilità," *Metron*, vol. i, No. 3, i-iv, 1921; F. Vince, "Nuovi contributi allo studio della distribuzione dei redditi," *Giornale degli Economisti*, Nov., 1921; *Statistica metodologica* (Padova, La Litotipo, 1924).

(29.) See also on this subject, R. Benini, *Principi di Statistica metodologica*, pp. 308-321; my *Appunti di Statistica*, 3rd edition, pp. 631-640; and the article "Intorno al metodo dei residui e alle sue applicazioni alle scienze biologiche e sociali," *Studi Economico-giuridici della R. Università di Cagliari*, 1910.

(30.) See my *Appunti di Statistica*, in the 2nd edition by Bittarello, which, from this point of view, is the best; L. Livi, *Elementi di Statistica*, Padova, C.E.D.A.M., 1926; V. Castrilli, *Lezioni di Statistica metodologica*, Palermo, Castiglia, 1925.

REPORT OF THE COUNCIL

For the FINANCIAL YEAR ended December 31, 1925, and for the SESSIONAL YEAR ending June 15, 1926, presented at the NINETY-SECOND ANNUAL GENERAL MEETING of the ROYAL STATISTICAL SOCIETY, held in the Hall of the Royal Society of Arts, John Street, Adelphi, W.C. 2, on June 15, 1926.

THE Council have the honour to submit their Ninety-second Annual Report.

The roll of Fellows on December 31 last, as compared with the average of the previous ten years, was as follows :—

Particulars.	1925.	Average of the Previous Ten Years.
Number of Fellows on December 31	1,030	889
Life Fellows included in the above	195	180
Number lost by death, withdrawal, or default	51	47
New Fellows elected	79	73

Since January 1 last, 44 new Fellows have been elected or restored to the list, and the Society has lost 26 by death, resignation, or default, so that the number on the list, excluding Honorary Fellows, on June 15, 1926, is 1,048, compared with 1,003 on June 16 last year.

Since June, 1925, the Society has lost by death the under-mentioned Fellows :—

	Date of Election.
<i>d</i> Arkell, George E.	1906
<i>c d p</i> †Baines, Sir J. A.	1881
*Barrett, Thomas S.	1887

c Served on Council.

d Donor to the Library.

p Contributor to Proceedings of the Society.

* Life Fellow.

† Guy Medallist.

						Date of Election.
		Bolitho, Thomas R.	....	....	....	1881
<i>d</i>		*Carter, Joseph R.....	....	....	....	1883
<i>d</i>		Dawson, Sidney S.	....	....	....	1903
		Desai, M. H.	....	....	....	1920
<i>c d p</i>		†Edgeworth, Professor Francis Y.	....	....	....	1883
<i>c d p</i>		Elliott, Sir Thomas H.	....	....	....	1885
		Gibb, Sir George S.	...	...	....	1885
		*Kusaka, Yoshio . .	...	...	....	1878
		Oldham, Prof. C. H.	...	...	....	1919
<i>d</i>		*Pim, John T.	...	...	...	1878
		*Scarth, Major L. . .	....	...	...	1887
		Sedgwick, Leonard J.	....	....	...	1922

Honorary Fellows.

<i>d</i>	Czuber, Emanuel . .	....	...	...	....	1923
<i>d</i>	Mayr, Dr. Georg von	....	...	....	...	1877
<i>d</i>	Tisserand, Eugène....	....	...	...	...	1910
<i>d p</i>	Tschuprow, Alex A.	....	....	....	...	1923

c Served on Council.

d Donor to the Library.

p Contributor to Proceedings of the Society.

* Life Fellow.

† Guy Medallist.

Though the list of deaths this year is somewhat shorter than usual, it includes the names of two Fellows who were intimately connected with the Society and its activities for many years, and whose loss is deeply deplored by the Society both collectively and individually. Though more extended references to their services to statistical science are contained in the obituary notices which have appeared in the *Journal*, the Council may be permitted to speak briefly of their colleagues.

Sir J. A. Baines had been a Fellow since 1881, during which period he had served frequently on the Council and its Committees, and had held the office of Honorary Secretary (1896-1909) and President (1909); his numerous contributions to the *Journal* form a mine of information for the student of demography, and his practical sagacity was always at the service of his colleagues.

Professor F. Y. Edgeworth had also been a Fellow for well over forty years, had served frequently on the Council, and was President for the years 1912-14; the papers he contributed to the *Journal*

are a not unimportant part of the life work which secures his place amongst the great masters of Economic and Statistical Science. His personal qualities won the affection of all who knew him; even within a few days of his death he rendered the Society an important service.

The death of Sir George S. Gibb deprives the Society of one who contributed to the discussion on papers dealing with railways and transport, subjects of which his knowledge was unrivalled.

The Council have also learned with regret of the loss of Sir T. A. Coghlan, who was for many years closely connected with the Society and, from 1893 to 1905, during his tenure of the office of Government Statistician of New South Wales, was an Honorary Fellow. After his appointment as Agent-General of New South Wales, Sir Timothy Coghlan resided in London and served several years on the Council. He exercised an important and beneficial influence on the development of statistics in Australia.

Sir Thomas H. Elliott, an old Civil Servant, is another Member of the Council who has recently passed away. Sir Thomas was a Fellow of the Society for over forty years, a Vice-President during several sessions, and contributed a paper in 1887 on "Annual Taxes on Property and Income." He was also a donor to the Society's Library.

The Council also records with regret the deaths of four Honorary Fellows: Dr. von Mayr, the author of *Die Gesetzmässigkeit im Gesellschaftsleben* and that monumental work *Statistik und Gesellschaftslehre*, was elected in 1877: M. Tisserand, an authority on agricultural statistics and an ex-President of the Statistical Society of Paris; and the distinguished mathematicians Professor Czuber and Professor Tschuprow. The premature death of Professor Tschuprow has deprived the world of a great master of statistical science, still in his prime. Professor Czuber's works have educated more than one generation of students, and he displayed to the last receptiveness to new methods and powers of lucid exposition.

Since June, 1925, the following new Fellows have been elected :—

Arlott, David.	Leheta, Mahomed F.
Avery, William P.	Lithgow, Richard.
Bass, Jack.	McDougall, Frank L.
Bergman, Harry.	Mahalanobis, P. C.
Bernard, Mrs. Frances F.	Mallett, Cecil F.
Blake, Alfred B.	Martin, Ernest J.
Blake, Stephen B.	Menken, Jules.
Borg, Charles J. N.	Mudaliar, V. L.
Brattle, Wilfred P.	Myers, Ernest J.
Brigstocke, William O.	Orme, William T.
Bryant, Miss E. J. M.	Overton, Arnold E.
Burraston, Victor H.	Purkayastha, K. C.
Caddick, Archibald F.	Redford, Arthur.
Calvert, Eric R.	Richards, William E.
Chenalls, Alfred T.	Ritchie, Alan B.
Coates, Herbert E.	Sawkins, D. T.
Cover, John H.	Shaffner, Felix I.
Cox, Harold.	Shehata, L.
Davies, Lewis H. L.	Shields, Bernard F.
Elkin, Miss W. A.	Shimmin, Arnold N.
Fleetwood, Clarence	Sirkin, David.
Forrest, Arthur E.	Sladen, Norman St. B.
Fox, John C.	Sparrow, Ben W.
Freke, Cecil G.	Spray, Charles H.
George, Percy F.	Stocks, Percy.
George, Ronald F.	Stone, James.
Gilchrist, Robert N.	Suffell, Eric G.
Grove, E. T. N.	Tatham-Thompson, D. A.
Gurevich, David.	Taylor, E. Miles.
Habakkuk, Evan G.	Taylor, Fred. H.
Haizelden, Alfred E.	Terry, Leslie A.
Herbert, Frank.	Thomas, Fred W.
Hill, Austin B.	Thomas, John.
Hinchliffe, Arthur.	Thielfall, Harvey.
Hoblyn, Thomas N.	Walton, Victor.
Hodgkin, Thomas W.	Watson, J. B. Forbes.
Hunt, John H.	Weeks, Hugh T.
Irwin, Joseph.	Weida, Frank M.
Jain, Laksmi C.	Winters, Richard J.
Jones, Ivor M.	Woods, Hilda M.
Kelefas, Andrew.	Woodson, Eugene R.
Laslett, Albert J. W.	

Representatives of Corporate Bodies :—

Deporte, Dr. J. V.	<i>representing</i> The New York State Department of Health.
Kemp, D.	<i>representing</i> The British Engineers' Association (Incorp.).
Mackinnon, D. A. W.	<i>representing</i> The Royal Mail Steam Packet Company (in place of H. B. N. Eyton).
Spicer, R. H. S.	<i>representing</i> The Engineering and Allied Employers' National Federation.

In the Session 1925–26, 86 new Fellows were elected, and the total number of Ordinary Fellows is now 1,048.

The financial position of the Society is shown in the tables on pp. 732–735 and in the report of the Auditors, to which little need be added by way of explanation. The tables showing receipts and expenditure, and the statement of assets and liabilities, have been supplemented, at the request of the Auditors, by a second column, giving the corresponding figures of the previous year, for more ready comparison. The total expenditure in 1925 was £2,962, compared with £2,970 in 1924. The net receipts in 1925, excluding compositions, were £2,860, compared with £2,785 in 1924, an increase of £75. The sales of the *Journal* amounted to £806, an increase of £140 over the preceding year, due in part to sales of sets or partial sets of the *Journal*.

The number of Fellows continues to show a satisfactory increase, the number on the list at the end of 1925, 1,030, being then a record. It is hoped that the number may increase still further, and likewise the sale of the *Journal*, as, owing to the high cost of printing and other services, the work of the Society can only be carried on efficiently with adequate income furnished from these sources.

The Ordinary Meetings have been held in each month of the Session, with the exception of May, and the papers read before the Society were as follows :—

- 1925.
- I.—November 17 ... YULE, G. Udny, C.B.E., M.A., F.R.S. Why do we sometimes get Nonsense-Correlations between Time-Series ?—a Study in Sampling and the Nature of Time-Series. (Presidential Address.)
- II.—December 15 ... REW, Sir Henry, K.C.B. The International Statistical Institute and its Sixteenth Session.
- III.—December 16 SHIMMIN, Arnold N. Distribution of Employment in the Wool Textile Industry of the West Riding of Yorkshire.
- 1926.
- IV.—January 19 THOMPSON, R. J. The Productivity of British and Danish Farming.
- V.—February 16 SCOTT, H. C. Some Administrative Aspects of the Rignano Scheme of Inheritance Taxation.
- VI.—March 16 EDGE, Major P. G. The Growth of Mortality due to Motor Vehicles in England and Wales, 1904–23.
- VII.—April 20 MACROSTY, H. W. Statistics of British Shipping.
- VIII.—May 18 (Not held, owing to the General Strike.)
- IX.—June 15 SNOW, Dr. E. C. Some Observations on Trade Forecasting and Prices.

During the past year the Society, for the first time in its existence, held a meeting away from London. The meeting was at Leeds University in December last, was well attended, and gave to many of the Fellows of the Society living in the north an opportunity of being present at a meeting which would otherwise have been denied them. A paper of more than local interest was read on the occasion, gave rise to an interesting discussion, and was well noticed in the Yorkshire press.

The Frances Wood Memorial Prize was offered for the third time in 1925. Six essays were received, and the prize of £30 was awarded to Mr. Christopher Tatham Brunner, F.S.S., for his essay "An Inquiry into Local Variations in the Birth-rate." The prize will be offered again in 1927.

The Library has been enriched by a gift of books by Mrs. Dudfield from the library of the late Dr. Dudfield, including his volumes of the *Journal*. and the Council much appreciate this donation from the widow of their late colleague.

The Royal Commission on the Coal Industry (1925), having asked the advice of the Council on certain technical points relating to the measurement of wages and cost of living, a special Committee was appointed to draft a report on these points, which was forwarded to the Coal Commission as a confidential document.

In view of the uncertainty regarding the means of communication, the Council decided to cancel the Ordinary Meeting in May. In this course they followed the decision of other learned societies, deeming it undesirable to hold a purely formal meeting at which, whatever subject were brought forward, an adequate discussion could not be secured.

Some correspondence has passed between the Royal Economic Society and this Society in reference to the prospective position of learned societies with respect to income-tax. The Council have decided, in principle, to associate themselves with the Royal Economic Society and other societies in joint action, if and when difficulties arise in this connection.

The new sectional volume of the Index to the Contents of the *Journal*, covering the sixteen years 1909-24, is now ready. The form is more concise than that of the earlier volumes, as the précis of the papers is omitted. It is thought that, as these details are given in the annual indexes issued with the July number of the *Journal*, their omission will not diminish materially the usefulness of the general index. It may be obtained by Fellows of the Society for the price of 1s., and by the general public for 2s. 6d.

The number of additions to the Library and the statistics of its use by Fellows and others will be found in Appendix C. The monthly average of volumes lent during the year ending May 31, 1926, was 135, and that of borrowers 59.

The Fellows named below (nominated in accordance with By-law 14) are recommended for election as President, Council and Officers of the Society for the Session 1926–27 :—

PRESIDENT.

The Right Hon. Viscount D'Abernon, G.C.M.G.

COUNCIL.

*James Bonar, LL.D.	David Heron, D.Sc.
S. Chapman.	John Hilton.
W. H. Coates.	Alfred Hoare.
Clara E. Collet.	Robert Holland-Martin, C.B.
*Norman E. Crump.	*Leon Isserlis, D.Sc.
W. Palin Elderton, C.B.E.	A. W. Waterlow King, J.P.
Barnard Ellinger, C.B.E.	H. W. Macrosty, O.B.E.
Dorothy P. Etlinger.	C. P. Sanger.
*Oswald T. Falk, C.B.E.	E. C. Snow, D.Sc.
Alfred W. Flux, C.B.	J. Calvert Spensley, O.B.E.
Sir D. Drummond Fraser, K.B.E.	Sir J. C. Stamp, G.B.E., D.Sc.
Major Greenwood, F.R.C.P.	T. H. C. Stevenson, C.B.E., M.D.
Sir William H. Hamer, M.D., F.R.C.P.	Robert J. Thompson, C.B.
Sir E. J. Harper.	Duncan R. Wilson.
*R. G. Hawtrey.	*George H. Wood.

Those marked * are proposed as new Members of Council.

HONORARY TREASURER.

Robert Holland-Martin, C.B.

HONORARY SECRETARIES.

A. W. Flux, C.B. M. Greenwood, F.R.C.P.

Sir J. C. Stamp, G.B.E., D.Sc.

HONORARY FOREIGN SECRETARY.

A. W. Flux, C.B.

The abstract of the Treasurer's account of receipts and payments and the estimate of assets and liabilities on December 31, 1925, together with the report of the Auditors on the accounts for the year 1925, are appended.

Signed on behalf of the Council,

G. UDNY YULE,

President.

A. W. FLUX,

M. GREENWOOD,

J. C. STAMP,

} *Hon. Secretaries.*

APPENDICES TO
A.—(i) ABSTRACT of RECEIPTS and PAYMENTS

Year 1924.			RECEIPTS.		Year 1925.		
£	s.	d.	Balance at 31 Dec., 1924:—		£	s.	d.
177	18	2	At Bank	...	95	19	2
13	11		Petty Cash	...	2	4	8
178	12	1			98	3	10
41	7	6	Frances Wood Memorial Fund	...	29	2	6
219	19	7					127 6 4
55	18	0	{ Dividends on £2,236 11s. 3d., Consols, Account A }		55	18	0
263	3	8	{ Dividends on £10,527 12s. 3d., Consols, Account B }		263	3	8
30	18	4	{ Dividends on £666 Pref. and £266 Ord. Stock, L.N.E. Rly. }		31	5	0
38	16	2	{ Dividends on War Bonds and Conversion Loan... }		38	16	2
—			Interest on deposit	...	9	8	10
388	16	2					398 11 8
1,440	12	0	Annual Subscriptions:—				
138	12	0	676 for 1925	...	1,419	12	0
58	16	0	55 Arrears	...	115	10	0
			36 in Advance	...	75	12	0
1,638	0	0					1,610 14 0
105	0	0	Life Compositions	...	...	...	189 0 0
666	5	10	Journal sales	...	806	10	11
13	5	0	Journal advertisements	...	13	17	6
2	19	9	Catalogue sales	...	0	12	0
682	10	7					821 0 5
11	12	3	*Repayment of Income Tax due to Society, 1923–24	...	...	...	—
60	10	6	Royal Economic Society and others, for use of rooms...	...	...	...	30 0 0
3	16	2	Miscellaneous	...	...	...	—
15	10	0	Frances Wood Memorial Fund:—				
2	5	0	Divs. received, 1925	...	15	12	6
17	15	0	Income Tax refund...	...	—		
							15 12 6

£3,128 0 3

£3,192 4 11

* The Income Tax on Government and Metropolitan Stocks has not been deducted at source since 1921–22.

“February 3, 1926.”

A.—(ii) ESTIMATE of ASSETS and

Year 1924.			LIABILITIES.	Year 1925.		
£	s.	d.		£	s.	d.
202	7	4	{ Miscellaneous Ac- counts, as per list }	231	10	0
58	16	0	{ Subscriptions received in advance (36) ... }	75	12	0
—			{ Journal subscriptions received in advance }	98	10	0
261	3	4		405	12	0
29	2	6	{ Balance due to the Frances Wood Memorial Fund }	—		
290	5	10				
8,883	0	6	{ Balance in favour of the Society (exclusive of (1) Books in Library; (2) Journals in Stock; and (3) Pictures, Fur- niture and Fixtures }	8,192	17	1
£9,173	6	4		£8,598	9	1

A.—(iii) BUILDING FUND (ESTABLISHED July 10, 1873) :

This Fund is invested in Metropolitan Consolidated £3 10s. per Cent. Stock, With the dividends received during 1925, additional Stock to the value total investment amounted to £854 8s. 1d. (Price, December 31, 1925,

A.—(iv) THE FRANCES WOOD MEMORIAL FUND :

This Fund is invested in £500 4 per Cent. Preference Stock, London Midland and follows :—In hand at December 31, 1924, £29 2s. 6d. ; Dividends received, a balance to the credit of the Fund at December 31, 1925, of £14 15s.

“February 3, 1926.”

LIABILITIES on DECEMBER 31, 1925

Year 1924.			ASSETS.		Year 1925.		
£	s.	d.	Cash Balances:—		£	s.	d.
125	1	8	At Bank ...	...	34	5	11
2	4	8	Petty cash ...	...	1	3	2
<hr/>					<hr/>		
127	6	4			35 9 1		
1,286	0	0	{ £2,236 11s. 3d. Con- sols (General Fund). (Price, December 31, 1925, £55) say ... }		1,230	0	0
6,053	0	0	{ £10,527 12s. 3d. Con- sols (Guy Be- quest). (Price, December 31, 1925, £55) say ... }		5,790	0	0
106	0	0	{ £100 5 per cent. Na- tional War Bonds 1927. (Price, De- cember 31, 1925, £105) say ... }		105	0	0
761	0	0	{ £966 3½ per Cent. Conversion Loan, (Price, December 31, 1925, £75 5s.) say ... }		727	0	0
535	0	0	{ £666 4 per Cent. 2nd Preference Stock, L. & N.E. Rly. (Price, December 31, 1925, £62) say ... }		413	0	0
221	0	0	{ £266 5 per Cent. Pre- ferred Ordinary Stock, L. & N.E. Rly. (Price, De- cember 31, 1925, £59 10s.) say ... }		158	0	0
<hr/>					<hr/>		
8,962	0	0	Sundry debtors ...		8,423	0	0
—			(Arrears of Subscriptions recover- able, say 40 ...)		56	0	0
84	0	0			84	0	0
<hr/>					<hr/>		
£9,173	6	4			£8,598	9	1

STATEMENT of the FUND on DECEMBER 31, 1925.

and on December 31, 1924, the Fund was represented by £823 14s. 8d. Stock. of £60 13s. 5d. was purchased. Accordingly, on December 31, 1925, the £95.)

STATEMENT of the FUND on DECEMBER 31, 1925.

Scottish Railway. The position of the income of the Fund in 1925 was as £15 12s. 6d., making a total of £44 15s. £30 was expended as a prize, leaving (Price, December 31, 1925, £73).

(Signed)

“M. S. BIRKETT, F. A. A. MENZLER, J. C. SPENSLEY, *Auditors.*”

A.—(v) REPORT OF THE AUDITORS FOR 1925.

The Auditors appointed to examine the Treasurer's Accounts for the Year 1925,

“REPORT :—

“*That they have compared the Entries in the Books with the Vouchers for the same, from January 1 to December 31, 1925, and find them correct, showing that the net RECEIPTS, excluding £189 life compositions, were £2,860 6s. 1d., and the PAYMENTS were £2,962 0s. 10d., leaving a deficit of £101 14s. 9d., the whole of which is to be ascribed to the expenditure on salary for work on the subject-index to the Library (£180). The deficit was again met by drawing on the life compositions received to the extent of £39, and on the balance of cash in hand to the extent of £62 14s. 9d. (the Bank Balance being decreased by £61 13s. 3d., and the Petty Cash Balance by £1 1s. 6d.). The Society's invested assets and deposit account should be regarded as ear-marked on account of a Life Composition Fund to the extent of £871 10s., as compared with £682 10s. at the end of 1924.*

“*They have also had laid before them an Estimate of the Assets and Liabilities of the Society at the same date, the FORMER amounting to £8,598 9s. 1d., and the LATTER to £405 12s., leaving an excess of Assets over Liabilities of £8,192 17s. 1d., EXCLUSIVE of (1) Books in the Library; (2) Journals, &c., in Stock; and (3) Pictures, Furniture and Fixtures.*

“*They have VERIFIED the Investments of the Society's General Funds (£2,236 11s. 3d. Consols, £966 3½ per cent. Conversion Loan, £100 5 per cent. National War Bonds, 1927, £666 L. & N.E.R. 4 per cent. Second Preference Stock and £266 L. & N.E.R. 5 per cent. Preferred Ordinary Stock); the Guy Bequest (£10,527 12s. 3d. Consols); the Building Fund (£854 8s. 1d. Metropolitan Consolidated 3½ per cent. Stock); the Frances Wood Memorial Fund (£500 4 per cent. L.M. & Scottish Railway Preference Stock); and also the Banker's balance (£49 0s. 11d.); all of which were examined and found correct. The market prices at December 31, 1925, have been adopted in valuing the Society's investments.*

“*They further find that at the end of the year 1924 the number of FELLOWS on the list was 1,002, which number was reduced in the course*

of the year 1925 to the extent of 51, by Death, Resignation, or Default ; and that 79 new Fellows were elected or restored to the list, leaving on the list on December 31, 1925, 1,030 Fellows of the Society, of whom 195 were compounders.

(Signed) “ M. S. BIRKETT,
 “ F. A. A. MENZLER, } *Auditors.*”
 “ J. C. SPENSLEY, }

“ *February 3, 1926.*”

B.—Statement of the Condition of the Society in the last Twenty-five Years, 1901-1925.

Year.	Number of Fellows on the D.O. number 31.	Number of Life Fellows included therein.	Losses during Year by Deaths, &c.	Gains by Election, &c., during Year.	Annual Subscriptions.	Receipts from			All Sources.	Payments.		Amount invested on D.O. number 31.	Year.	
						Com. post- fuctions.	Journal Sales.	Invest- ments, &c.		Total.	On Journal.			On Library
					£	£	£	£	£	£	£	£		
1901...	926	177	49	52	1,464	63	211	129	1,867	1,823	518	42	3,300	1901
'02...	932	177	52	58	1,504	21	255	152	1,932	1,839	543	73	3,300	'02
'03...	939	174	49	58	1,517	84	293	151	2,045	1,875	593	91	3,300	'03
'04...	926	175	58	44	1,407	124	253	152	1,936	1,931	521	92	3,400	'04
'05...	911	178	59	45	1,465	168	220	220	2,073	2,074 ^m	665	67	11,975 ⁿ	'05
'06...	891	177	63	43	1,464	82	225	408	2,274 ⁿ	1,988	645	95	11,448	'06
'07...	861	172	63	33	1,363	82	327 ⁿ	408	2,180	2,401 ⁿ	571	87	11,746	'07
'08...	855	170	46	40	1,359	84	254	494 ^r	2,171 ^r	2,428 ^r	602	92	11,920	'08
'09...	825	167	82	52	1,307	84	273	396	2,060	2,369	641	99	12,084	'09
1910...	845	172	37	57	1,304	141	326	974 ^t	2,746 ^t	2,736 ⁿ	803	74	11,210	1910
'11...	867	174	40	62	1,415	126	308	405	2,255	2,372 ⁿ	721	104	10,875	'11
'12...	854	175	57	44	1,336	105	334	382	2,157	2,174	776	81	10,599	'12
'13...	846	174	61	53	1,331	84	294	390	2,108	2,058	671	79	10,092	'13
'14...	821	169	64	39	1,281	42	271	489 ^r	2,083	2,319 ^r	813	88	9,528	'14
'15...	772	163	61	12	1,243	63	268	351	1,925	1,803	448	40	8,182	'15
'16...	758	163	48	34	1,181	42	325	302	1,850	1,655	507	36	7,702	'16
'17...	767	161	41	40	1,186	52	311	305	1,854	1,732 ^r	403	54	7,656	'17
'18...	761	167	43	47	1,132	222	305	459	2,118	1,900 ^r	665	32	8,282	'18
'19...	796	172	56	91	1,297	273	603	286	2,459	2,784 ^r	782	50	7,672	'19
1920...	882	180	37	123	1,373	250	730	291	2,739	2,838	951	99	6,847	1920
'21...	916	186	48	112	1,480	*	661	279	2,783	2,827	887	94	7,605	'21
'22...	969	187	48	71	1,499	*	688	345	3,009	3,383 ^r	951	103	8,604	'22
'23...	996	195	39	66	1,476	*	738	387	2,856	2,940	853	107	8,666	'23
'24...	1,002	194	62	68	1,638	*	666	389	2,785	2,970	850	137	8,962	'24
'25...	1,030	195	51	79	1,611	*	806	398	2,860	2,962	872	116	8,423	'25

¹ Includes purchase of Government stock.² Exclusive of Building Fund.³ Includes £100 to International Statistical Congress Fund.⁴ Includes the Guy Bequest. The total invested is now valued at current prices.⁵ Including £120 for sale of books.⁶ Includes purchase of £600 G.N.R. Stock.⁷ Includes special sales.⁸ Includes Sanford Bequest, £100.⁹ Includes £160 for Catalogue and £288 for purchase of Stock.¹⁰ Includes £500 from sale of Consols and £88 Income Tax refunded.¹¹ Includes £436 for re-decoration of premises, installing electric light, and furniture.¹² Includes £160 for furniture and carpets and "at home" expenses.¹³ Includes £100 to International Statistical Institute.¹⁴ Includes £100 raised by sale of £134 14s. 9d. Consols for the purpose of note x.¹⁵ Includes purchase of National War Bonds.¹⁶ Treated as capital from 1921 onwards; see Auditors' Report, p. 736¹⁷ Of which £575 was extraordinary expenditure (Catalogue and Index).

C.—*Estimated Numbers of Books Added to the Library and Lent, and Numbers of Borrowers from the Library in the Sessional Years 1923-24, 1924-25 and 1925-26.*

Months.	Works Received.*		Books Lent.						Borrowers.		Months.
	1923-24. 1924-25. 1925-26		1923-24.		1924-25.		1925-26.		1923-24.	1924-25. 1925-26.	
			Works.	Vols.	Works.	Vols.	Works.	Vols.			
1925.											1925.
June	—	—	68	83	101	119	101	108	35	57	June
July	600	636	54	69	68	77	85	96	33	46	July
August	—	—	41	55	62	76	54	72	23	33	August
September	—	—	62	76	91	105	87	104	39	43	September
October	—	—	88	119	128	142	151	177	46	67	October
November	—	—	122	153	140	181	167	185	71	75	November
December	—	—	73	85	126	164	115	128	46	59	December
1926.											1926.
January	370	277	99	110	121	149	140	181	66	60	January
February	—	—	111	144	127	147	172	202	60	63	February
March	120	243	110	127	122	136	134	159	52	73	March
April	—	—	106	119	105	124	109	117	55	68	April
May	175	184	116	128	111	120	91	98	54	47	May
12 months	1265	1340	1050	1268	1302	1540	1406	1627	580	691	12 months
Monthly average	100	112	87	105	108	128	117	135	48	57	Monthly average

* These figures represent the number of works entered during the year, under "Additions to the Library," in the *Journal*, and not the number of separate volumes; they are exclusive of about 200 weekly, monthly, and quarterly periodicals regularly received.

D.—(i) Comparison of Income, 1915-25.

	1915.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.
	£	£	£	£	£	£	£	£	£	£	£
Dividends and interest (excluding those on special funds)...	318	284	270	274	276	291	279	345	387	389	399
Income tax refunds	—	—	—	107	108	108	109	109	33	11	—
Annual subscriptions	1,243	1,181	1,186	1,131	1,296	1,373	1,480	1,499	1,476	1,038	1,611
Journal sales	268	325	311	304	602	740	687	688	738	666	806
„ advertisements	22	7	9	3	3	3	17	23	17	13	14
Catalogue sales	—	—	—	—	—	—	—	9	3	3	1
Use of rooms, &c. (Royal Econ. Soc. and others) ...	35	35	35	35	35	120	60	60	60	60	30
Miscellaneous	—	—	—	—	—	—	1	3	2	4	—
Total ordinary receipts	1,886	1,833	1,817	1,855	2,320	2,535	2,633	2,737	2,716	2,784	2,861
Life compositions	63	42	52	222	273	250	231*	126*	241*	105*	189*
	1,949	1,875	1,869	2,077	2,593	2,785	2,864	2,863	2,957	2,889	3,050

NOTE.—The figures in Appendix D do not exactly coincide with those in the Auditors' Annual Accounts and in Appendix B, the income and expenditure in these new tables having been allocated to the years in respect of which they were actually due and incurred.

* From 1921 onwards these sums have been placed to capital.

D.—(ii) Comparison of Expenditure, 1915-25.

	1915.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.
	£	£	£	£	£	£	£	£	£	£	£
Rent, including hire of hall, and taxes	399	399	404	398	400	398	421	429	429	429	416
Fuel, light, water	51	47	57	54	67	82	74	85	100	93	91
Insurance	27	27	21	21	16	17	17	17	17	17	14
Furniture, repairs, and office equipment	48	36	27	16	42	43	56	18	63	33	59
Salaries, wages, and Nat. Inse...	438	449	474	491	606	663	705	736	738	751	750
Pension	52	52	52	52	52	78	91	91	91	91	91
Housekeeping expenses	22	23	29	36	34	40	40	43	42	65	54
Journal costs, including re-purchase	452	457	435	591	669	841	881	904	853	850	872
Library (books and binding)	40	36	54	33	115	99	94	103	107	138	116
Advertising	23	15	30	26	34	22	17	9	21	24	23
Stationery and sundry printing	74	54	71	100	137	188	172	139	129	127	136
Postage and telephone	85	74	79	82	50	124	139	155	130	140	139
Miscellaneous, including medals...	17	13	9	15	30	31	28	10	21	9	10
Total ordinary expenditure	1,728	1,682	1,742	1,917	2,252	2,626	2,735	2,739	2,741	2,767	2,771
<i>Special expenditure.</i>											
Catalogues (salary and printing)...	—	—	—	11	180	180	180	600	180	180	180
Official Statistics Committee	—	—	—	—	51	3	—	—	—	—	—
Dinner to Statisticians	—	—	—	—	—	35	—	—	—	—	—
Leeds meeting expenses	—	—	—	—	—	—	—	—	—	—	10
Total	1,728	1,682	1,742	1,928	2,483	2,844	2,915	3,339	2,921	2,947	2,961

D.—(iii) Comparison of Total Income and Expenditure, 1915–25.

Year.	Income including Compositions placed to Income.	Expenditure (including Special).	Deficit (–) or Surplus (+).
	£	£	£
1915	1,949	1,728	+ 221
1916	1,875	1,682	+ 193
1917 ...	1,869	1,742	+ 127
1918	2,077	1,923	+ 149
1919 ..	2,593	2,483	+ 110
1920	2,785	2,844	– 59
1921 ...	2,634*	2,915	– 281
1922	2,737*	3,339†	– 602
1923 ..	2,716*	2,921	– 205
1924 ...	2,784*	2,947	– 163
1925 ...	2,861*	2,961	– 100

* Compositions received in and since 1921 have been placed to capital account (in 1921, £231; in 1922, £126; in 1923, £233; in 1924, £105; in 1925, £189).

† Includes £395 spent on printing of Catalogue, £122 only coming out of income.

D.—(iv) Comparison of Investments at December 31, 1913 and 1925.

Investments.	Nominal holding			Remarks.
	End 1913.		End 1925.	
	£	s. d.	£ s. d.	
Consols A	2,371	6 0	2,236 11 3	
„ B, Guy Bequest	10,527	12 3	10,527 12 3	
G.N.R. Pref. Conv. Ord. Stock.	1,000	0 0	—	
L.N.E.R., 4 per cent. Second Pref. Stock.	—		666 0 0	
L.N.E.R. 5 per cent. Pref. Ord. Stock.	—		266 0 0	
National War Bonds 5 per cent. 1927.	—		100 0 0	Legacy, Sir L. Probyn.
Conversion Loan ..	—		966 0 0	Conversion of £600 War Bonds representing savings during the war.
Total holding (General Fund) nominal values.	£13,898	18 3	£14,762 3 6	Total actual values are shown in Appendix B.

NOTE—(a) In addition to these holdings the Society has its Building Fund worth in 1914 £582 10s. 3d., and in 1925 £854 8s. 1d.

(b) At the end of 1914 the number of compounders was 169, and at the end of 1925 it was 195. Thus at the latter date £4,095 of capital represents life compositions, as against £3,549 in 1914.

PROCEEDINGS OF THE NINETY-SECOND ANNUAL GENERAL MEETING
OF THE ROYAL STATISTICAL SOCIETY, HELD IN THE HALL OF
THE ROYAL SOCIETY OF ARTS, ON JUNE 15, 1926.

The Chair was taken by the PRESIDENT, MR. G. UDNY YULE, C.B.E., F.R.S., at 6.45 p.m.

MR. A. W. FLUX, Honorary Secretary, read the circular convening the meeting.

The Report of the Council for the financial year 1925 and the Session 1925-6 was presented to the meeting and taken as read.

The CHAIRMAN then moved that the Report be adopted, entered in the Minutes, and printed in the *Journal*.

MR. C. F. RAWSON seconded the resolution, which was then put to the meeting and was carried unanimously.

The PRESIDENT announced that the names of the following persons had been removed from the roll according to Bye-law No. 9, their annual subscriptions to the Society having been in arrear for a period of three years or more :—

R. R. Aiyengar, E. F. Bone, M. N. Dinkhan, A. S. Firth,
J. P. Hodge, O. W. Hope, H. L. Kaji, J. J. McElligott,
D. MacMillan, P. Sabel, D. H. Steers, E. G. Underwood.

A ballot was taken for the election of the Council for the Session 1926-7, and all those named on the list were unanimously elected.

MR. G. H. WOOD proposed that a vote of thanks be accorded to the President, Officers and outgoing Council for their services to the Society during the past Session ; the resolution was seconded by Dr. BINNIE DUNLOP, and on being put to the vote was carried unanimously.

MR. ROBERT À ABABRELTON raised the question of replacing the letters F.S.S. by the letters F.R.S.S., which had been mentioned at the preceding Annual Meeting. He had addressed a letter on the subject to the President, and had anticipated that it would have been formally raised by the Council. He gave notice that he would propose an amendment to the Bye-laws in this sense at the next Annual Meeting. His letter to the President was referred for consideration to the Council.

The Proceedings then terminated.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS.

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1.—*A Contribution to the Study of the Human Factor in the Causation of Accidents*. By E. M. Newbold, B.A. (Report No. 34, Industrial Fatigue Research Board, Medical Research Council.) H.M. Stationery Office, 1926. Price 5s. net.

The experience of munition factories during the war led Greenwood and Woods to suspect that the distribution of accidents among persons exposed to similar risks is not one of pure chance. Some individuals are more likely to meet with an accident than others. The idea is not entirely novel. Roman matrons doubtless made caustic comments on the explanation offered by the Nubian slave that "the plate came to pieces in her hand." On the purely physical side few of us would care to trust ourselves to the hands of a short-sighted or deaf chauffeur or a colour-blind engine driver. Galton remarked on the preponderance of short men among distinguished military commanders. The taller officers ran greater risk of being hit and

so had less opportunity of reaching the age at which their military genius would meet with recognition.

The "susceptibility to accidents" considered by Greenwood and the subject of Miss Newbold's recent investigation is probably more a mental than a physical characteristic, and if its existence is a reality it is of the very greatest importance that the fact should be realized by those concerned in industries where trivial aberrations may lead to the gravest consequences. Persons whose susceptibility is greater than the average would then be directed to employments of a suitable nature, while powder factories, the flying corps, and the like, would be staffed as far as possible with non-susceptibles.

Miss Newbold has observed the distribution of 16,188 accidents among 8,962 workers, including 2,024 women, for periods varying from three months to two years in occupations ranging from the dipping of nuts into caramel for sweet-making to the making and assembling of motor-cars. The variety of occupations and the consequent variation in the physical conditions affecting liability to accident prevented any useful comparison of the accident frequency in the different occupations, but there emerge from the analysis many homogeneous groups, and the distribution of accidents within these groups leads to some very instructive results. In a factory making and assembling motor-cars 860 males were observed for a period of six months. They met with 3,420 reported accidents. The accidents were mostly trivial. The injured person would be away for a few minutes for treatment and then return to his work. In an eight-hour day a man who really meant business could have 50 accidents or so; the chance of an accident occurring in a small interval of time is therefore a small one, and Miss Newbold correctly assumes that if there were no personal idiosyncrasies among the workers with regard to liability to accidents the distribution would follow Poisson's exponential law. Applying this to the above figures, we should expect to find that 38 out of the 860 workers would meet with no accidents during the period and that 29 would meet with 10 accidents or more. As a matter of fact, 230 met with no accidents and 98 met with 10 or more. Practically all the groups show this bias, although not all to the same extent. There are more individuals with few accidents and more with many than would be indicated by pure chance. The author tests the applicability to these distributions of the hypotheses due to Greenwood and Yule, first that liability to accidents is altered by having sustained an accident, and, secondly, that there is an unequal distribution among the workers of susceptibility to accidents. The first hypothesis does not fit the facts, it would lead to bimodal distributions, and these do not occur. The second does. In the example we have already quoted it gives 199 as the expected number of workers with no accidents and 97 as the expected number with 10 accidents or more. An ingenious suggestion made by Miss Newbold is to take as a criterion not the mean number of accidents but the proportion of the group with no accidents, to the whole number. This leads

to a rough rule for the guidance of those in charge of the factory. Let f be the proportion of individuals with no accidents and m the mean number of accidents. Then, on the basis of pure chance, m should be equal to $-\log f$. A table of these values is provided. If m is much higher than the theoretical value, a search for the susceptibles with a view to their elimination is indicated. Space will not permit of a detailed reference to the rest of the author's analysis of her data. She finds that there is a tendency for the number of accidents to decrease to some extent with age, and that the apparent tendency for the number to decrease with length of service in the factory disappears when allowance is made for age. It is true that the *mortality* from accidents increases with age, but that is due to the higher killing effect of the same accident on older individuals. Some notes on the probable errors of the constants involved, included in the appendices, add to the value of the report. Many firms co-operated in the enquiry. The Medical Research Council is fortunate in securing the co-operation of industry, and the able way in which the data so provided are handled by the Council's staff should still further increase industry's confidence in the Council's reports.

L. I.

2.—*A Study in Vocational Guidance*. Carried out by the Industrial Fatigue Research Board and the National Institute of Industrial Psychology. Report No. 33. Industrial Fatigue Research Board. viii + 106 pp. London: H.M. Stationery Office, 1926. Price 4s. net.

The square peg in the round hole is a common enough sight under modern conditions of labour, a sign of economic loss and waste. Any means that can be devised for eliminating such inefficiency and discontent, and utilizing the human material available to the best of its capabilities, are obviously of high importance. The method applied in attacking this problem in the past few years has been mainly that of vocational *selection*, i.e. the analysis of the requirements of particular occupations followed by an attempt, on the basis of this analysis, to select persons possessing the necessary qualifications for the specific work. More important, if methods can be devised to utilize it, is the idea of vocational *guidance*, i.e. the analysis of the particular individual followed by a choice of the specific work most likely to suit his abilities and temperament.

The one method is, obviously, merely the complement of the other: analysis both of the person and of the employment is essential in either case. As this report points out, vocational guidance must be based upon "thorough-going investigations by means of so-called job-analysis. To study from a psychological standpoint the differences between individual children will be worthless, without making a similar study of the peculiar requirements of different trades and occupations."

However, the inquiry here discussed, since it was the first of its

kind in this country, aimed rather at formulating some scheme of organization; at devising, and assessing the value of, ways and means of judging the characteristics of each child; and at proving by a careful statistical analysis whether the individual differences thus found would be so distinct as to form a satisfactory basis for vocational guidance. "The most complete determination possible of the personal qualities of each individual child, and of the inter-relation of these qualities, was the object aimed at rather than the estimation of the practical value of the tests as judged by the subsequent history of the subjects tested."

The work involved, an intensive individual study of 100 children, was carried out by four investigators working under the direction of Professor Cyril Burt.

In each case the home of the child was visited and notes taken upon the social and economic status, the occupation of the parents, and any factors that through heredity might be of importance. The child's medical history was studied by means of the school medical inspection records, and his "school history" gleaned from the teachers. The child was submitted to a series of tests, verbal and non-verbal, devised to check intelligence, mechanical ability, natural aptitudes for specific trades, scholarship and the like. (Some of these tests will make the adult blanch. "Draw roughly and in outline eight tea-pots all as different in shape from each other as possible"; and, again, "the children were asked to imagine themselves the Postmaster-General requiring a new pillar-box very different from those in present use, and with many improvements. They were given four minutes to sketch such a pillar-box." No child seems to have answered this question sufficiently well for the vocational advice to be "Postmaster-General," but a Prime Minister in want of a person for this post should note that the girls beat the boys!)

A very fair and full discussion is given of these tests and of their limitations. Many of them, the investigators freely admit, are imperfect and merely of an experimental nature.

Finally, each child was submitted to a personal interview and an endeavour then made to assess the emotional, moral and social qualities. Other experimental methods which were devised to test the value of this last assessment indicate that it cannot be ranked very high.

On the basis of all these data, collected together for each child and analysed, vocational recommendations were made.

After an interval of two years, the homes of the children were re-visited and inquiry made as to the type of occupation finally adopted by the child and the success resulting from the choice. Professor Burt thus summarizes the results obtained: "Judged by the after-histories of the several children, those who entered occupations of the kind recommended have proved both efficient and contented in their work. As compared with their fellows they are, on an average, in receipt of higher pay; they have generally obtained

promotion earlier: they have experienced fewer changes of situation, and have incurred hardly a single dismissal between them. Over 80 per cent. declare themselves satisfied alike with the work they have taken and with their prospects and their pay. On the other hand, of those who obtained employment different from the kind advised, less than 40 per cent. are satisfied. Among the latter group nearly half dislike their work."

As is repeatedly pointed out in the report, too much stress must not be laid upon these figures. The experiment was only on a very small scale, and the results are therefore liable to high probable errors.

The more important result is that sufficient has been done to show that this type of investigation is feasible, in spite of the many complex factors involved, and that it is well worth while to carry it out on a larger scale in order to secure more definite evidence.

One or two points suggest themselves to the reader. A little more attention might, perhaps, be devoted to the question of the parents' employment. It is well known that many boys follow the father's career, and the correlation between father and son, through heredity and environmental upbringing, is often sufficient justification for this. Where, however, the father dislikes or is unsuccessful in his work, the vocational adviser would have further grounds for advising the boy, on the basis of this parental correlation, not to follow the same career.

One would have liked to see a table of the distribution of intelligence among the two groups of children—the successes and the failures. Did both groups include children of high, low and medium intelligence, or was there a preponderance of any type in either group? For instance, dull children might preponderate in the satisfied group, and be satisfied merely through lack of ambition.

The evidence in favour of the personal interview is not entirely convincing. It is difficult to rid oneself altogether of the feeling that psychological observers may give like judgments, not because these judgments are true but because the observers have the same methods. As psychologists they may have been trained to take note of the same evidence and to make similar deductions on the basis of this evidence.

More information will, no doubt, be gained on these and many other interesting points in the similar investigation that is now being carried out on a larger scale by the National Institute of Industrial Psychology. Their report will be awaited with interest.

A. B. H.

3.—*The Christian Ethic as an Economic Factor: the Social Service Lecture, 1926.* By Sir Josiah Stamp, G.B.E., D.Sc., F.B.A. 106 pp. London: Epworth Press, 1926. Price 2s. net.

A little book of just over a hundred pages, representing "The Social Service Lecture, 1926," in a somewhat expanded form, and bearing the above title, might not appear to everyone to be likely

to be a compendium of fundamental economic conceptions set forth in relation to some of the most vital problems of our lives to-day. It will be no surprise, however, to those who know the lecturer to find that this is the case. Sir Josiah Stamp passes under critical review in these pages several of the popular short cuts to the millennium, and indicates the nature of the limits within which attempts to improve the world in which we live, by treating its economic problems on a plan which ignores the conditions in which the problems arise, can hope for success. Where necessary the results of his own statistical work on wealth and income are cited to illustrate the argument. In his insistence on the need for careful study of the nature of these problems and of the information that may be available regarding the magnitude of the elements involved he will have the hearty concurrence of the Fellows of our Society. While giving expression to the warmest sympathy with certain popular aspirations, and indicating how ethical influences can contribute towards their attainment by modifying the motives and desires of men in the mass, he rightly says: "There is nothing in ethics which can *compel* a given territory and organization to support a population of a particular size at a particular level of existence, though much current discussion seems tacitly to assume that if enough moral indignation is aroused the miracle can be worked."

Two appendices "On Spending" and "On Saving" furnish, among other things, an examination of the possibilities of raising general social conditions by directing our spending and the application of our savings in appropriate channels, while a third "On redistribution of the standard of living" conveniently repeats material relating to the National Income which has appeared in the Press in another connection.

A. W. F.

4.—*The Economics of Private Enterprise*. By J. H. Jones, M.A., Professor of Economics and Head of the Commerce Department, University of Leeds. x + 444 pp. London: Pitman & Sons, Ltd., 1926. Price 7s. 6d. net.

This book is intended for first-year University students and for candidates for the business professions, and the author has sought, successfully, to keep his exposition simple and free from technicalities. In a preliminary survey he discusses such general themes as specialization and co-operation, the purpose of production, the economic order, and the nature of economic study. Next, he describes the structure of economic society of to-day, indicating how it has developed, the problems it has created, and the explanations which economic theory has to offer. "Economic Valuation," in the third book, introduces the student to the theory of prices, money and international trade, and the theory of distribution, while the problem of employment, the trade cycle, and the standard of living occupy the fourth and concluding part of the volume. The book may be recommended for the purposes for which it was written, and though most of the difficult problems are left on one side, the author

may contemplate a continuation in the interests of more advanced students. Incidentally, he regards "the discussion of measures of reform as beyond the scope of economic science, though not beyond the province of economists." This view may be suitable for an elementary treatise, but if "economic science," utilizing abundant and accurate statistics, has nothing to say in the discussion of proposals for the reform of the evils of society, one is inclined to wonder what critical apparatus "economists" are to bring to the aid of statesmen.

H. W. M.

5.—*British War Budgets*. By F. W. Hirst and J. E. Allen. (Carnegie Endowment for International Peace.) xiv + 495 + 18 pp. London: H. Milford, 1926. Price 15s. net.

This book is rather a history of Budget debates than of Budgets. "As a rule," the authors say in their preface, "we have allowed the parliamentary actors to speak for themselves and criticize or answer one another. But we have not hesitated on occasion to express our own views or to sum up where we found a conflict of opinion on important matters."

A book constructed on this plan has the great merit of reviving the atmosphere in which the financial plans were successively conceived and criticized. The official view is expounded in the opening Budget statement, which is in each case fully summarized.

Nevertheless, some readers will certainly regret that there is not a little more of the authors' own views and a little less of the pronouncements of the politicians of the time. The authors have indeed done their best to compress and sift the mass of shallow and ill-informed comment of which Budget debates are mainly composed. But they have been too conscientious in preserving the general proportions of the debates.

Parliamentary discussion is governed by a selection of those topics on which there is a difference of opinion, or rather on which Members think it advisable that their differences of opinion should be made known. That selection has very little relation to the real importance or interest of the topics from an administrative or financial point of view. Grievances against the minor imperfections, injustices or hardships, of the administration of particular taxes are ventilated. Political controversies about protection, or the taxation of tea and sugar, or heavy direct taxation, play their part in the conflict between parties. Individual Members put forward schemes to illustrate their own views of constructive statesmanship. But amid all this argument the financial problem of each year does not emerge as a distinct whole. Even Ministers' Budget statements do not quite fill the gap.

The book will, therefore, be of most interest to those who already know something of the financial history of the period with which it deals (1914-24). Taken for its limited purpose it is well done.

Unfortunately it is not free from inaccuracies, sometimes of more

than minor importance. On p. 351 there is attributed to the Financial Secretary of the Treasury the statement: "It is estimated that the total expenditure of the United Kingdom on the war between August, 1914, and November, 1920, was £11,196,927,000." What the Financial Secretary actually said was: "The total Exchequer issues in the case of the United Kingdom from August 3rd, 1914, to March 31st, 1920, were £11,196,927,000." The misquotation, which is made the more misleading by *oratio recta* and inverted commas, attributes to an official source an estimate of war expenditure which is really an estimate of *total* expenditure.

On p. 97 we are told that Mr. McKenna "agreed" with Colonel Wedgwood's argument that the depreciated American exchange acted as "a protection against American imports." A more accurate version would have been that, with a suitable polite circumlocution, he *disagreed*.

Other examples might be cited, and there are also too many cases in which Members of Parliament quoted inaccurate facts or figures and the authors have left them without comment. The fact is that the House of Commons is not the place to look for accuracy of statement. Even Ministers, officially briefed, are not free from the taint. The authors, in their historical introduction, quote a very interesting discourse on the history of the Income Tax from Gladstone's Budget speech of 1853. Unfortunately, Gladstone contrived to leave out altogether the imposition of the schedular income tax with taxation at source by Addington in 1803, and, by saying that "from 1806 to 1815 you had the income tax in its full force," to suggest that the whole credit was due to Pitt. That version of history has gained currency, and the authors might reasonably plead that they cannot be blamed for adopting it without question.

The authors are, on the whole, more interested in expenditure than in the financial expedients resorted to for meeting it. Underlying their criticisms of taxation and of borrowing is the emphatic belief that expenditure, both during and after the war, ought to have been greatly reduced. From this standpoint their method of proceeding almost exclusively through a discussion of Budget debates is ill-advised. References to expenditure, apart from vague generalities, are out of order in a Budget debate. Nor is much informed criticism of expenditure to be found in parliamentary debates at all. The authors do not seem to have consulted many sources of information on the subject of expenditure outside the debates. They say (p. 16) that "for the period of the war no figures [of Army and Navy expenditure] are available, as only token votes were taken," as if they had never seen the Vote of Credit Appropriation Accounts.

Of the Civil Service Votes for 1919-20, amounting to £495,614,000, they say: "the National Education grant alone rose from £13,272,625 in 1907 to £41,251,000 in 1919-20, and the swollen bureaucracy was responsible for a large proportion of the balance." If by "swollen bureaucracy" Civil Service personnel is meant, this

statement is entirely inaccurate. The total excludes the Post Office, Inland Revenue, Customs, War Office, Admiralty and Air Ministry staffs, so that the sum included for salaries in the £495 million is small and is but a moderate proportion of the cost of the bureaucracy.

R. G. H.

6.—*The Amalgamation Movement in English Banking, 1825–1924.* By Joseph Sykes, B.A.(Leeds), M.Com.(Manchester). Assistant Lecturer in Economics, University College, Exeter. xi + 231 pp. London: P. S. King, 1926. Price 10s. 6d. net.

This is an extremely useful book on a little-studied part of our financial history. The growth of banking in its early years was slow, and the Act of 1708, by limiting the partners in a banking firm (except the Bank of England) to six, definitely confined banking to small local organizations. There were only 230 private country banks in 1797, about 600 in 1808, and about 721 in 1810. Failures were numerous, and in 1825 the number of private banks was reduced to 554 with 681 branches. The Act of 1826 allowed the formation of joint-stock banks, except in London, where it was not permitted till 1833. This reform led to the amalgamation or absorption of a large number of weak private banks, and between 1826 and 1843 (including 17 absorbed at unknown dates) 122 banks, of which 6 were joint-stock, were absorbed. In 1841 there were only 311 private banks and 118 new joint-stock banks. During the bank mania of 1836 there were founded 47 joint-stock banks, and 32 banks were absorbed. The legislation of 1844 discouraged the fusion of joint-stock banks, especially with London houses, and in the period 1844–61 there were only 44 absorptions, although the gold discoveries and the development of communications naturally stimulated banking. The Companies Act of 1862 removed the restrictions on joint-stock banking, and between that year and 1889 there were 138 amalgamations; the Overend & Gurney failure accelerated the movement, and "the desire to secure increased size, branch growth, and speedy development" was an efficient cause of absorption. Between 1890 and 1902 there were 153 amalgamations, involving the disappearance of 102 private and 51 joint-stock banks, and the end of this period marks the break-up of the private-bank system. The Baring crisis had a stimulating effect, while the inadequacy of bank reserves, stigmatized by Lord Goschen in 1890, and the competition of the larger banks in the matter of size were additional factors. Later, war finance had a powerful influence, but the rivalry of the "Big Five" was even more important, and between 1903 and 1924 there were 95 amalgamations, 37 private and 58 joint-stock banks being absorbed. At the end of 1924 there were only 2 private firms with 2 branches, compared with 13 joint-stock firms with 8,021 branches.

Discussion of the effects of amalgamation (accompanied by much statistical material) occupies most of the second part of the book. The chief points made by the author are: "1. Amalgamation has

caused the regular reduction of capital and reserves. 2. It has fostered the growth of deposits through the regular development of branch policy, the reduction of note issues, and the emergence of large strong banks. It has tended to make deposit figures more truly representative of prevailing conditions, by the elimination of duplication. 3. Cash holdings and cash reserves have been slightly increased, while investments have become more scientifically arranged, so that greater liquidity, stability, and safety have been secured." 4. Up to a point the results of the branch policy "have been economically and socially beneficial, not the least important of these being the growth of effective, keen, and incessant competition"; but of late years the development has been overdone. 5. "On the whole, amalgamation has increased the capacity to make loans: but the mechanical and impersonal control imposed by the organization necessary in great concerns has tended to reduce the initiative of smaller entrepreneurs and business men, and is an obstacle to quick recovery from acute trading depression." This conclusion will be strongly contested, and to some extent it is contradicted by the evidence which the large banks have adduced as to the assistance given by them to agriculture. 6. "The emergence of large concerns has made for more stable working and rendered possible that degree of combined action which is occasionally of especial value. . . . 8. Amalgamation has perceptibly reduced the smooth and elastic working of the Money Market, and affected the effective work done by private firms. Further, the rearing-up of great banks is not without dangers to the position of the Bank of England." . . . 11. Expenses of management have increased through wasteful competition.

The author thinks that the Midland, Lloyds, and Barclays have reached their limits, but that further development of the Union and Westminster Banks may be possible. Judicious amalgamation might also improve the position in the Lancashire group. If the number of English banks be reduced below 7, the possibility of combined working may become a reality, and steps should be taken to circumvent such a policy. Here we enter a territory of violent controversy in which the author's views (as also his conclusion as to the detrimental effects on the Money Market) will meet with strong opposition. This is not the place to continue the debate, and we must conclude by heartily commending a most excellent book.

H. W. M.

7.—*Banking Policy and the Price Level.* By D. H. Robertson, M.A. 103 pp. London: P. S. King, 1926. Price 5s. net.

This book is excellent reading. It has comparatively little to do with the second part of its title, and it would drive the average banker into a life of retirement at Colney Hatch or Hanwell; but for all that it is well worth serious study. Briefly, what the author has set out to do is to analyse the claims of the two schools of thought on the trade cycle, and, as might be expected of Professor

Robertson, he disagrees with both. Some critics might complain that, like Alice, he displays a nasty vicious temper, but he conceals it so well, and summons to his aid such a masterly exposition of the facts as he sees them, that any such criticism is soon lost in admiration.

Where he possibly breaks down is in his neglect of the human element and in his tacit assumption that economics and statistics are exact sciences. Confront a bank manager with this book, and tell him that he must use it as his guide in the conduct of his daily business, and his first reply would be that it was all "——nonsense." Press him further, and he would answer that his business was to know how much money he had to lend and what were the credentials of his would-be borrowers, and that when he had correlated the two, all that remained was to give or refuse his sanctions to the various loans. And though we may regret that the average banker is prone to regard his business in this matter-of-fact light, yet we cannot deny that he has attained a certain solid measure of success in the past.

The other weakness of the book lies in the author's failure to realize how incomplete are the data at present at the banker's command. Professor Robertson has elaborated and solved a masterly series of equations, and in determining the x 's and y 's he has performed a notable service. He has, however, been forced to assume that the a 's, b 's and c 's are readily and accurately ascertainable. He has postulated that facts can be presented in a manner recalling the incisive logic and exactitude of the Red Queen, while too often, alas, they correspond more to the sloppy vagueness of the dormouse. It is no use setting a banker to draw water when there is no guarantee that the well does not contain treacle.

All this is not so much a criticism of Professor Robertson's work as of the lamentable lack of economic data, a lack which most Fellows of our Society have had frequent occasion to deplore. Professor Robertson has done his work well. His definition of the various forms of capital is well worth serious consideration by every worker in this field. We may smile at his new language, while admiring him for his courage in inflicting it with scant warning upon his reader. We cannot, however, help feeling that he is writing of an unreal world, that he has strayed overmuch into the tempting paths of pure theory, and that he owes his public a second essay in which he will consent to come closer to this hard inexact world as it is to-day.

N. E. C.

8.—*Wages and the State*. A comparative study of the problems of State Wage Regulation. By E. M. Burns, B.Sc.(Econ.). 443 pp., demy 8vo. London: P. S. King, 1926. Price 16s. net.

The author has divided the methods of enacting minimum wages into three main groups under the titles of the Fixed Minimum Wage, the Board System, and the Arbitration System. "The point common

to all these methods is the legal enforcement of the rate decided upon, whether it be stated in an Act of Parliament, decided upon by the representatives of a trade, or awarded by a third party. In all cases the State makes itself responsible for enforcing the payment of the wages, either by the institution of criminal proceedings for non-payment or by recourse to other sanctions." Part I contains an account of the extent of wage-regulation and the methods adopted in different countries; Part II deals with problems of technique, and Part III with problems of principle.

Elimination of the unessential is rigidly adhered to throughout, and the few passages in which actual rates or percentages are mentioned would be better omitted. The uninitiated reader will derive a curious notion of conditions in Australia from the statement, without amplification, that "New South Wales is typical of the general form in enacting that: 'No workman or shop assistant shall be employed unless in the receipt of a weekly wage of at least four shillings a week.' Before leaving this [Fixed Minimum Wage] method it is worth noting that there is a very wide divergence between the wages thus fixed. These range from a minimum of two shillings and sixpence a week payable in Victoria to one of ten dollars in Arizona, or thirty-five shillings in Western Australia."

The excellence of the method adopted and the variety of interest in the subject-matter can only be indicated by quotations of brief examples. Closing a study of regulation by Arbitration, "it remains to decide whether the Court should be empowered to deal with all kinds of disputes. In Queensland it cannot deal with State Children, domestic servants and persons engaged in agriculture; in West Australia it may not limit the working hours of persons engaged in agriculture or pastoral industries; in Kansas it may intervene only in disputes which endanger the supply of vital services (including food and manufacture); in South Australia the conditions of Government servants may be regulated only on the authority of both Houses of Parliament; the Federal Court may take cognizance of those disputes alone which extend beyond the borders of one State; in New Zealand and the Commonwealth, unless the Court itself intervenes, its assistance can only be invoked by *registered unions*."

Part III, which discusses the different bases on which minimum wages have been fixed, is most valuable, the judicial pronouncements in the Australian Courts being of special importance. "The Living Wage is the most widely prescribed wage-fixing principle. It is now embodied in the wage-regulating Acts of New South Wales, West Australia, and all the American States which adopt the Board system, except Massachusetts, in Manitoba, Nova Scotia, and Saskatchewan in Canada, and was in the British Corn Production Act of 1917." In New South Wales in 1922 "the Broken Hill Proprietary Company applied for a reduction in wages on the grounds that it was making no profits, and reductions were at first allowed, but on appeal the full Court held that no such reductions should have been made, and intimated that if it was impossible for the works to continue to

exist and pay a Living Wage, and if it was felt to be of national importance that they should continue, 'the workers should not be called upon to pay for the benefit of the community,' but the cost should be met by a subsidy out of the proceeds by taxation." The New Zealand Court in 1922 declared "that while it would allow no worker to receive less than a Living Wage *as declared*, yet the 'actual fair standard of living must vary with the prosperity of trade and industry and the degree of efficiency attained.' The same conclusion was reached by the New South Wales Board of Trade, which from 1919 recognized that 'the standard underlying the wage was not a thing which was stationary' and later intimated that it was closely related to the total productivity of the State."

The book should be a most useful guide to the study of the official reports of the various wage-regulating States. C. E. C.

9.—*Co-operation at Home and Abroad*. By C. R. Fay, M.A., D.Sc., Professor of Economic History, University of Toronto. xvi + 481 pp. London: P. S. King, 1925. Price 15s. net.

In issuing his third edition of *Co-operation*, Dr. Fay has left the main text and the first supplement unaltered, but he has added a second supplement on Agricultural Co-operation in the Canadian West, which is the result of a summer spent there in 1922, followed by reading and by conversations with co-operative authorities. The second edition was reviewed in this *Journal* for July, 1920 (p. 695), and the present reviewer has confined himself to the new matter presented in supplement two.

Historically, the co-operative movement in the prairie provinces is a confluence of two streams—the informal co-operation of farmer pioneers and the dissatisfaction of the wheat grower with the treatment received from the railway companies and line elevators. In 1916 was formed the Grain Growers' Grain Company (later known as the United Grain Growers, Ltd.), an organization that worked in close association with the local farmers' co-operative organizations. Beginning with sales on commission it soon entered the export business and acquired its own elevators; subsequently, with the aid of subsidiary companies, it extended its activities to the supply of farmers' requirements. Substantial profits have been made on marketing, but there has been a comparative lack of success in supply, a reversal of the general experience of European countries.

Co-operative marketing of farm products has also been a success in Saskatchewan, where the distinguishing features have been the financial support given by the provincial government, the thoroughness of local organization and the excellent annual reports issued.

British Columbia is a country of speciality farming, and co-operative effort has been concentrated upon marketing, principally of dairy products and fruit. Supply is operated economically as a return traffic. In its initial stages the movement was subsidized by Government loans, but the Act of 1920 makes all associations dependent in future upon their own resources.

There is an interesting section on wheat pools. During the war the Canadian wheat crop was marketed by a Wheat Board. Reversion to ordinary trade conditions caused a slump in 1920-21, and the farmers started an agitation which led to the formation of the Alberta wheat pool in 1923 and of the Saskatchewan and Manitoba wheat pools in 1924. Entry into the pool is, of course, optional, and contracts run until 1927 and bind members to deliver all the wheat grown by them except registered seed. By 1924 half the prairie wheat crop was marketed by the three pools, which possessed an aggregate membership of 90,000 and controlled 11 million acres of wheat land. Dr. Fay thinks the dangers threatening the pools are extravagant expectations of the extent to which prices can be stabilized at a more remunerative level, disloyalty and faintheartedness, and lack of co-ordination in co-operative effort. On the whole, wheat pools have been a success, and they have been followed by pools for the marketing of live stock and dairy products.

The supplement is in no sense a treatise; it really consists of a series of notes. Considerable progress has, however, been made in the matter of wheat pools since Dr. Fay paid his visit, and it is evident that any more elaborate study should be reserved until the movement has emerged from its present experimental stage.

L. R. C.

10.—*The Cotton Growing Countries, Present and Potential*. International Institute of Agriculture. xxxvi + 317 pp. London: P. S. King, 1926. Price 12s. 6d. net.

The present volume brings up to date and amplifies the statistical information collected by the International Institute of Agriculture and published in an earlier monograph (1922). The information, which now covers also potential cotton-growing areas, has been compiled partly from answers furnished to a questionnaire issued by the Institute, and partly from all other available, trustworthy sources. No pains have been spared to make the volume an authoritative review of the position in regard to the world production and consumption of cotton.

The Introduction and Summary and General Notes provide a succinct account of the salient facts. Apart from prefacing the statistics, they serve also as an interesting opening to the whole subject. One point, for example, may be mentioned: room is found for brief and salutary words of advice to the prospective creator of new plantations.

The main body of the monograph consists of separate statements of the position in each of the 79 countries concerned. The data are grouped, so far as is practicable, roughly according to the following plan: (a) authorities; (b) area and production; (c) principal cotton-growing districts; (d) periods of planting and picking; (e) production; (f) cotton plant enemies; (g) use of product (local manufacture and consumption, exports, imports, machinery and transport).

Tables are given at the end of the volume of the areas and production, averaged for the pre-war years (1909-13) and then separately for the years 1921-5; also for imports and exports for the same periods. Comparative tables are also appended of the mill consumption during the half-yearly periods of 1921-5 of American cotton, Egyptian cotton, East Indian cotton, and cotton from minor sources. Actual stocks in Liverpool of various descriptions of cotton are also given, as well as the prices, with index-numbers, ruling at Liverpool, New Orleans and Alexandria in each of the years 1913-25.

Not only does the monograph describe the special circumstances influencing the cotton crop in the particular countries, but it enables at the same time a clear realization of the essential facts in relation to the growing and consumption of cotton regarded as a single problem of world-wide importance.

The monograph undoubtedly supplies what is claimed; it is a handbook of ready information for all interested in the textile industry, whether from the practical side (on the plantation, in the trade or at the mill) or from the more technical and economic side.

It is nicely produced and printed. Only a few very minor misprints have been noticed. A. Z.

11.—*Mémoires et Documents pour servir à l'histoire du commerce et de l'industrie en France: Le Commerce maritime de la Bretagne au XVIII^e siècle*, par Henri Sée: et *Quelques professions connues, inconnues et méconnues*, par Julien Hayem. vii + 345 pp. Paris: Librairie Hachette, 1925.

This volume, the ninth of a series, contains, in the first place, a number of contributions by M. Henri Sée to the maritime history of Brittany in the eighteenth century. The most important study traces the commercial activities of the house of Magon in St. Malo throughout the century until the last representatives lost their heads in the Revolution. The main source of the author's materials is a collection of letters and other documents left by the merchants themselves, and herein lies the chief value of M. Sée's work.

Owing to the paucity and difficulty of the land communications of Brittany, St. Malo was driven to find its fortunes on the sea, and M. Sée presents us with a record of trading operations carried on with Spain, Portugal, Holland and other European countries, and with America, Africa and the East Indies. Linen, silk, hats and other French products were exported, and gold, silver, coffee, sugar, cotton and other products brought back. The firm of Magon also took a hand in the slave-trade, in the cod-fishing industry off Newfoundland, and for a short period filched some of the trade with Spanish America which Spain endeavoured to preserve for herself. Brief descriptions are given of the financial and shipping arrangements connected with these trading operations.

Towards the end of the century the depreciation of the French currency created difficulties for the traders of St. Malo—how history repeats itself!—but the worst blow was struck by the outbreak of

war with England, and for the next twenty years the commercial activities of the port were transformed into the guerilla operations of the privateer.

This study is followed by essays on the unsuccessful efforts of St. Malo to acquire the privileges of a free port; on the economic and social life—poor in range and character—of St. Malo on the eve of the Revolution; on the means taken to bring the commercial affairs of St. Malo before the authorities, in the absence of a Chamber of Commerce; on the commerce of Morlaix and Nantes; and on a number of other topics.

M. Sée has not attempted to provide anything like a complete survey of the commerce of Brittany in the eighteenth century, nor to show its relation to the general commercial history of France. That was not his purpose. All that he set out to do was to furnish a series of footnotes to a small epoch in economic history, of which students will be glad to avail themselves.

Besides these side-lights on some eighteenth century history, the book contains a report by the editor, M. Julien Hayem, on "Some professions or occupations known, unknown, and unrecognized," which was originally prepared for the Commission set up by the Ministry of Finance in 1918 to determine what should be, in certain eventualities, the assumed profits of industrial and commercial concerns for the purpose of the tax on profits imposed by a law of 1917. M. Hayem surveyed part of the field covered by the Commission and has reprinted his results in the present volume. The "professions" investigated by him include big retail stores, commercial bazaars, publicity and travel agents, labour bureaux, commission agents, undertakers, theatres, music halls, cinemas, itinerant merchants, racehorse trainers, and many others, making up altogether a very motley collection. M. Hayem's object was to ascertain as well as he could the relation of the annual profits to the turnover, so that, failing a proper declaration of profits by the taxpayer, he could be assessed to the tax on an assumed profit which presumably bore some relation to facts.

We are not concerned with the fiscal aspects of this piece of work. As a historical document it is cursory and very circumscribed, but it may well possess a certain value to students in the future. Such students, however, will regret that the notes are not more exhaustive and do not cover a wider field.

A. D. W.

12.—*Constitution, Functions and Finance of Indian Municipalities.* By K. T. Shah and G. H. Bahadurji, M.A., L.T.C.L. 514 pp. London: P. S. King, 1926. 25s.

This is a large volume, mainly dealing with Indian municipalities, but referring frequently to European, especially English and German, and American methods. The authors are for adopting in India nearly every suggestion that can be derived from other countries sometimes, it must be said, taking rather too optimistic a view of the advantages which might be obtained.

There is a considerable body of information about the constitution and functions of the municipalities of Bombay, Calcutta, Madras, and Rangoon, but not much concerning other cities. Bombay, perhaps deservedly, receives most attention, and the chapter (pp. 122-8) purporting to give something like a verbatim report of proceedings in an ordinary day in the Bombay Council is interesting reading, bringing out something of the difference in atmosphere between India and western countries, as well as illustrating a substantial degree of similarity.

The qualification for a vote for the municipal elections in Bombay is the occupation, as owner or tenant, of a building or part of a building, as a dwelling or for business purposes, of which the monthly rental is not less than ten rupees. This is stated to be fairly typical of Indian municipalities, only rather more liberal than most.

In Bombay about 90,000 have votes, in Calcutta about 70,000. The special vote accorded to University graduates has been abolished in Bombay but still exists in other places.

The authors are all for the extension of the franchise, and would ignore prejudices relating to the "untouchables" and to the position of women. or, at least, they suggest that the difficulties could be surmounted.

A difference from English practice is found in the existence in India of executive officers, as distinct from technical specialists, in many cases appointed by, and responsible to, the Government. Bombay has a Commissioner who is a member of the Civil Service. The position and functions of executive officers are not everywhere the same. In the main they are servants of the corporation, but their position is, no doubt, to a certain extent anomalous. The authors do not favour the principle of having such officers drawn from the general civil service. There is some discussion of the relationship of executive officers to the corporations, which would be more illuminating, however, if more detailed information were given as to what they actually do in India.

The authors argue in favour of a general municipal service, selected by examination analogous to the State Civil Service but independent of it. If the difficulties of transfer from one town to another can be adequately overcome, the objection that executive officers are not wedded definitely to their own town, but are birds of passage, would be much the same under the authors' proposal, and it is not very clear why an interchange with the general civil service should not be mutually advantageous to some extent.

Municipal revenue in India is obtained in much the same way as in England, but the rates are an appreciably smaller percentage of rateable value than in this country. The authors desire to see the municipalities extend their activities immensely, to provide free and universal primary education, hospitals, better housing, etc., but not to increase taxation. They have a touching faith in the power of the municipality to take over and manage all kinds of undertakings, including even the cotton mills of Bombay, and to get

substantial profits in relief of taxation. They also advocate the inclusion of personal property in the rateable values, and taxation of capital values instead of annual or monthly values, but without discussing the serious difficulties and evasions to which the attempt to tax personal property leads in America for instance.

One would like to see more explanation of the way in which the electorate functions. From figures on p. 78 it appears that the proportion of voters actually voting in a Bombay general election was higher than is now usual in London, though usually much less than half of the total entitled to vote. What is the position as regards parties? One infers that they are not much developed. The authors say they want principle rather than parties, but we would like to see more information and critical discussion of the actual working of the electoral system.

Remembering the useful service which enthusiasm rendered in the early days of the London County Council, one must not complain if there is something of this attitude displayed in this book. That enthusiasm has in a large measure diminished in London, because so much of the work has been already accomplished, and the limitations of the powers of democratic municipalities have begun to be felt. The authors want the Indian municipalities to do everything which socialists demand of the State in this country. The municipality is their subject, and they would multiply its activities in all sorts of directions which even socialists here would regard as scarcely within their scope. If this will help to get up steam for the efficient carrying out of more limited duties it will serve a useful purpose, for it is evident that a far more difficult task confronts the municipalities of India to-day, in the matter of drainage, housing improvement and public health generally, than that which confronted the London County Council at its inception. There are many years of hard work to be done in these directions before the municipalities need consider launching out into other spheres. C. F. B.

13.—Other New Publications.*

Batten (Edward), M.I.Mech.E. *National Economics for Britain's Day of Need.* xi + 217 pp. London: Pitman, Ltd., 1926. Price 5s. net.

[Mr. Batten discusses the problem of foreign trade as part of the "rationing" of our population. Against the Protectionist and the Free Trader he is a "Relativist," believing not in dogma but seeking for "wise conduct in the existing environment." After a pungent exposure of the capacity of people for holding contradictory beliefs, he rejects both Free Trade and Protection as infallible principles and declares for "Preference." The last third of the book is concerned with a discussion of monetary problems. He holds that, while the

* See also "Additions to the Library," p. 790 *et seq.*

gold standard is necessary for international trade, there should be a domestic standard so regulated as to maintain a constant price in domestic currency for our exports, thus putting sheltered and unsheltered trades on equal economic conditions. [The book is brightly written and is certainly provocative of thought.]

Bonar (J.), LL.D. The Tables Turned. A lecture and dialogue on Adam Smith and the Classical Economists, 19th January, 1926. 52 pp. London: P. S. King, 1926. Price 2s. net.

[One of seven lectures in which the London School of Economics commemorated the 150th anniversary of the *Wealth of Nations*. In the author's words, it "attempts to show in what a changed world we live since the days of the Great Founder." The first part of the lecture briefly discusses the achievement of the Classical Economists and their place in history. In the second part the audience is taken to Elysium, there to listen to a dialogue between Adam Smith, Ricardo, Karl Marx, John Stuart Mill, "a son of our own time," and others, in which the contrasts between the theories and expectations of the sage and his followers and the conditions of the present day are entertainingly brought out. Dr. Smith ends the conference with the alliterative admonition, "Prudent Political Economists, Proscribe Prognostications," and Dr. Bonar continues his commentary, summing up his tribute in the final phrase, "Commemoration a hundred and fifty years after the service rendered is rightly reserved for the Master Builders."]

Germany. Bibliographie der Sozialwissenschaften. Herausgegeben vom Statistischen Reichsamt. XXII Jahrgang. 1926. Heft 4. Berlin, 1926.

[The German Statistical Office has for some years past issued a bibliography of literature including both books and periodicals relating to the social sciences in the principal countries of the world. The subjects are grouped under ten heads, some of which are again sub-divided, an arrangement convenient and helpful to the reader. The fourth issue has recently been published. The bibliography should be a boon to those engaged in economic research.]

Godfrey (Ernest H.). Growth and Organization of the Canadian Grain Trade. 32 pp. 1925.

[A reprint of a paper from the *Journal of the Royal Agricultural Society* giving an account of the progress of the Canadian grain trade, including methods of production, storage, transport and delivery on the European markets. The study also includes an account of Canadian grain legislation and of the flour- and grist-milling industry.]

Hassinger (Dr. Hugo). Die Tschechoslowakei. ix + 618 pp. Wien: Rikola Verlag, 1925. Price 18 marks.

[This is a handbook of geographical, political and economic information relating to Czechoslovakia. A considerable portion of the book is devoted to discussion of the language and population problems—questions bound to arise, since the races which go to form the Republic are so many and diverse. Statistics of commodities exported and imported during recent years are given, together with their value in kronen, and there are also figures relating to agriculture, mining and other industries.

The appendices contain a list of the principal towns with their Czech, German and Polish or Magyar names; an account of official organizations and State administration, including budget figures for the years 1920 to 1925 and statistics of taxation; an extensive bibliography and two maps]

Hijar y Haro (Luis). Influencia de la Migración Europea en el desarrollo de los principales países de Sud America. 166 pp. Tacubaya, D.F. Mexico, 1924.

[A statistical study of European migration into the various South American Republics and of the effects on the economic and social conditions and development of these countries. The book also contains a report on rural colonization in Mexico.]

Johnes (Trevor), B.Com. Economic Theory and Practice. 156 pp. London: P. S. King, 1925. Price 5s.

[The author's endeavour has been to set forth in simple language what economic teaching and history have to say on certain leading questions of the day, and to emphasize the hardships that result from ignorance of economic laws. Among the subjects treated are the possibility of raising wages and the extent to which trades unions can bring about such increases, the gold standard, national debts, the Dawes Scheme, trade cycles, and the division of the product of industry. There is no index.]

Keynes (John Maynard). The End of Laissez-faire. 54 pp. London: Hogarth Press, 1926. Price 2s. net.

[Though after a hundred years of almost unquestioned authority it is still apt to influence our judgment, the principle of non-interference by Governments has ceased to be taken for granted—"We hear but indistinctly what were once the clearest and most distinguishable voices which have ever instructed political mankind." Mr. Keynes, after tracing the origin of the doctrine of *laissez-faire* and analysing the causes of its supremacy in this country, comes, in Chapter IV of his little book, to the consideration of the extent, direction and manner of control which might suitably be exercised by the State. Doctrinaire State Socialism is ruled out "because it is . . . little better than a dusty survival of a plan to meet the problems of fifty years ago based on a misunderstanding of what someone said a hundred years ago"; and it is suggested that "progress lies in the growth and recognition of semi-autonomous bodies within the State," a development which, as the author points out, is in the direct line of the evolution of Joint Stock institutions; and, further, that Government should aim not so much at replacing control by individuals as at doing "things which at present are not done at all." The collection and dissemination of economic data, the regulation of currency and investment, and the formulation of a national policy of population are instanced as appropriate governmental functions.]

Levy (Dr. Hermann). Der Weltmarkt 1913 und heute. iv + 116 pp. Leipzig: B. G. Teubner, 1926. Price 4 Reichsmarks.

[An interesting comparison of the world's trade and of general economic conditions in 1913 and at the present time. Among the subjects dealt with are costs of production and their increase since 1913, the disorganization of international trade due to fluctuating exchanges, and the regrouping and shifting of markets since the war.]

Millspaugh (A. C.). The Financial and Economic Situation of Persia. 32 pp. 1925.

[A useful summary of facts and figures, not hitherto readily available, compiled by the Administrator-General of the Finances of Persia. The information is largely taken from official sources.]

Prato (Giuseppe). Il Piemonte e gli effetti della guerra sulla sua vita economica e sociale. xv + 241 + 16 pp. Bari, 1925. Price 36 lire.

[Prof. Prato's book, which is one of the series of monographs of the Carnegie Foundation for International Peace, gives a general account of the effects of the war on the economic and social life of the province of Piedmont. The first chapter deals with population and the changes due to emigration and to the war. The three succeeding chapters are concerned with agriculture and industries, production, and the social conditions of workers. The fifth is devoted to the City of Turin in its social and economic aspects, and the remaining chapter is a study of the social life of the people and the adverse effects the war has had on some of their characteristics.]

Ramaiya (A.), M.A. Monetary Reform in India. 64 pp. Madras: G. A. Natesan & Co., 1926. Price R. 1.

[The author's aim is to describe briefly some of the main aspects of Indian currency and exchange, to indicate the real defects in the existing system and methods for their removal, and to suggest in which directions reforms should be made. The work is based largely on a statement previously submitted to the Indian Currency Commission, and claims to be without political bias.]

Rees (J. Morgan), M.A. Unemployment as an International Problem. 188 pp. London: P. S. King, 1926. Price 10s. 6d. net.

[The author has apparently aimed at elucidating the connection between unemployment and foreign policy. Part I of the book is headed "A survey of the Post-War Economic Problems in relation to the Treaty of Versailles," and reviews, firstly, the international political and economic situation at the close of the war and, secondly, the effects of the Treaty on foreign trade. Part II, on the fluctuations of Unemployment, 1914-24, includes chapters on "General Theories of Unemployment" and "Population and Migration." Mr. Rees has brought together a number of facts and figures, chiefly compiled from other publications, but it cannot be said that his treatment has thrown new light on the question of unemployment, and the book is made both dull and difficult by the clumsy and often ungrammatical language in which it is written. We pick a few samples at random: "Despite the great publicity made of the fact" (p. 63); "The vicious system of taking boys into blind alley employments and keeping them until eighteen with the comparative certainty then of being replaced by another boy could be prevented" (p. 151); "The serious economic effect of this was seen in the Turks rising from their ashes as it were in Angora . . ." (p. 5). The opening paragraph of Chapter VII is a multiple and flagrant example.]

A Social Survey of the City of Edinburgh. Printed for the Council of Social Service. vii + 102 pp. Edinburgh: Oliver & Boyd, 1926. Price 1s.

[This little book, introduced by a preface by Sir Richard Lodge, contains a brief historical sketch, and articles on public health, housing, education, adult education, education under school age, maternity and child welfare, sickness and disablement, industry, recreation, delinquency, mental disorders and defects, and public and voluntary assistance by as many qualified contributors. Elementary statistics, appropriate to the subject, are given in the various chapters, and there is also a chart of death-rates and a table giving the vital statistics of the wards of the City in 1924. The book is an excellent introduction to the social problems of Edinburgh. It may well serve as a model to those ambitious of undertaking in other areas work similar to that done by the Council of Social Service, but it would have been improved by the addition of a rough sketch-map of the City area.]

Wasserman (Max. J.). L'œuvre de la Federal Trade Commission . . . avec une Préface de Edouard Lambert. xlii + 582 pp., 8vo. Paris: Marcel Giard, 1925. Price 50 frs.

[A legal and economic study of the powers and activities of the Federal Trade Commission with respect to the regulation of industry in the United States. The book opens with a description of the economic, social and political elements in the events which led up to the federal regulation of commerce, first by the Interstate Commerce Act of 1887, and later by the Sherman Act of 1890, the creation of the Bureau of Corporations in 1893, and its supersession in 1914 by the Federal Trade Commission. Later chapters relate to the organization and powers of the Commission, its procedure and decisions in cases dealing with restraint of trade and other irregular practices. The remainder of the book deals with the effects of the Commission upon American export trade, its participation in the economic mobilization of industry during the war, and its policy in regard to "Trade practice submittals." In conclusion the author reviews the work of the Commission as a whole and the criticisms that it has evoked. Professor Lambert's preface gives an interesting survey of the question in its international aspects. The appendices contain translations of the various Acts cited above, a list of the publications of the Commission, a bibliography and an index. A final note describes the recent changes in procedure that have been made by the Commission.]

Watkins (Allen), M.A., and Taylor (E. Miles), F.C.A. Economics for Examinees. First Edition. x + 120 pp. London: Macdonald & Evans, 1926. Price 6s. net.

[A brief summary of the principles of economics for the use of students. Definitions of technical terms are included, and special attention has been given to modern theories, such as the marginal theory of value, as set out by Marshall, the quantity theory of money, as expounded by Keynes and other modern writers, and the theory of purchasing power parity as formulated by Professors Cassel and Irving Fisher.]

CURRENT NOTES.

THE record of our foreign trade in May and June is remarkable in the relatively moderate effect produced by the stoppage of coal production. So far as these figures reflect the situation, the country has borne with extraordinary fortitude the industrial injuries of the General Strike and of the continued dispute in the coal fields. In 1925 the coal and coke exports of May and June amounted to about 8,750,000 tons. This year the record shows nearly 1,600,000 tons, but it is clear that the delays in filing the records put in by exporters must be responsible for about 1,500,000 tons of this total. Adding in the reduction in bunker coal supplied to foreign-going steamers, we have a loss in the two months of about 11,000,000 tons of coal sold abroad or to steamers going foreign. The reactions of the stoppage on our exports of iron and steel in particular are serious in the extreme, since nearly all our blast furnaces are closed down. Production in other departments is hampered, and the maintenance of so large a proportion of our foreign trade is, in the circumstances, a reason for much satisfaction, both in itself and for its implications as to the extent to which the industrial activities of the country have been maintained.

In our usual tabular comparison, given below, of the principal sub-divisions of the foreign trade of the twelve months ended June in the current year and last year, the sharp set-back in the money values recorded needs to be considered in relation to the movement of prices, which has been generally downward.

	Twelve Months ended June, 1926.	Twelve Months ended June, 1925.	Increase (+) or Decrease (—) in later period.
Imports, c.i.f.—	£'000.	£'000.	£'000.
Food, drink and tobacco	552,700	587,731	— 35,031
Raw materials and articles mainly un- manufactured	395,603	427,699	— 32,096
Articles wholly or mainly manufac- tured	294,709	334,206	— 39,497
Other merchandise	4,879	7,005	— 2,126
Total imports*	1,247,886	1,356,665	— 108,779

* These figures include revisions of the calendar year aggregates, not available for other periods.

	Twelve Months ended June, 1926.	Twelve Months ended June, 1925.	Increase (+) or Decrease (—) in later period.			
Exports, f.o.b.—	£'000.	£'000	£'000			
<i>United Kingdom Pro- duce and Manufactures—</i>						
Food, drink and tobacco	52,157	58,057	—	5,900		
Raw materials and articles mainly un- manufactured	70,801	95,677	—	24,876		
Articles wholly or mainly manufac- tured	579,012	630,258	—	51,246		
Other merchandise	16,672	21,169	—	4,497		
<i>Imported Merchandise—</i>						
Food, drink and tobacco	29,009	30,889	—	980		
Raw materials and articles mainly un- manufactured	86,568	78,652	+	7,916		
Articles wholly or mainly manufac- tured	26,964	33,576	—	6,612		
Other merchandise	120	174	—	54		
Total exports	862,203	948,452	—	86,249		
Bullion and Specie—						
Imports	51,744	47,637	+	4,107		
Exports	52,402	47,746	+	4,656		
Movements of shipping in the Foreign Trade:	Number of Vessels	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.	Number of Vessels.	Thousand Net Tons.
<i>Entered with cargoes—</i>						
British	31,506	37,776	31,906	38,032	— 400	— 256
Foreign	23,179	17,518	22,777	18,523	+	402
Total	54,685	55,294	54,683	56,555	+	2
<i>Cleared with cargoes—</i>						
British	34,983	39,014	40,296	42,004	— 5,313	— 2,990
Foreign	18,840	18,718	23,996	22,431	— 5,156	— 3,713
Total	53,823	57,732	64,292	64,435	— 10,469	— 6,703

The calculations given in the Board of Trade *Journal* afford useful indications of the extent to which the price changes and to what extent changes in the volume of trade are responsible for the decreases in most of the lines in our table. From these calculations

we deduce that, on the import side, about five-ninths of the decrease shown is a question of prices, the remaining four-ninths a matter of quantities. In the food class, of the decrease of 6 per cent. shown in our table, about $2\frac{1}{2}$ per cent. appears to be due to decreased quantities imported; in the raw materials section the $7\frac{1}{2}$ per cent. decrease shown is due to prices changes and quantity changes in the proportion of about 5 to 1; and in the class of manufactured goods about two-thirds of the decrease of nearly 12 per cent. results from decreased quantities. In this case the anticipatory imports in the period immediately preceding the imposition of various customs duties on July 1, 1925, have affected the comparison of quantities imported in the two periods compared.

The decrease in British goods exported, shown in our table as $10\frac{3}{4}$ per cent., appears, on the same basis of calculation, to be due to decreased quantities to the extent of about one-third, and to lower values per unit of merchandise as regards the other two-thirds. The direct loss of exports of coal contributes under a third of the decrease in quantities. In the class of manufactured goods exported, the decrease of £51 millions appears to be divided in similar proportions to the aggregate decrease in the exports as a whole, namely, £17 millions due to reduced quantities and £34 millions due to lower values per unit of goods shipped.

The movement is shown in the following summary giving values calculated at the prices of 1924:—

Estimated values on the basis of 1924 prices.

	July, 1925—June, 1926	July, 1924—June, 1925.
	Million £	Million £.
Total imports	1,297·4	1,345·5
British exports ...	767·6	805·1
Re-exports	130·5	133·5

The changes in the shipping movement, shown in our table, reflect curiously the consequences of the stoppage in coal production. British vessels arriving with cargoes were fewer in the later period, while foreign vessels were more numerous but of smaller aggregate tonnage. An addition to the number of small vessels carrying coal from the Continent, while a decrease took place in the vessels of larger size visiting our ports, appears to be consistent with the record.

In the case of vessels clearing with cargoes, the absence of coal cargoes in May and June doubtless exercised the dominant influence on the changes shown in the total numbers and tonnage. The decreases in numbers of vessels were roughly the same for British vessels and foreign vessels, but in the former case the calls not represented in the record of the later year were, in larger degree than in the latter case, calls of vessels of a size below the average.

The Board of Trade's index-number of wholesale prices applied to average prices for the month of May revealed the first increase recorded since January of last year. The increase on April prices, amounting to 0.9 per cent., was due to higher prices for food, which rose by 4.2 per cent. On the assumption that coal prices in May were the same as in April, there was a further fall in the level for industrial materials, amounting to 0.7 per cent. Average prices in June showed a further increase of 1.0 per cent. on those of the preceding month. These figures included an allowance for the high prices paid in June for imported coal, which was reflected in an increase of 12.2 per cent. in the group of metals and minerals other than iron and steel, and was chiefly responsible for the net increase of 2.5 per cent. in the general level for industrial materials. Wholesale food prices were lower in June than in May by 1.5 per cent., lower averages being shown in each of the three groups of food-stuffs. On the total index-number, having as its base the average level of prices for the year 1924, the effect of these changes was a rise from 86.4 for April to 87.2 for May, followed by a further increase to 88.1 in June. If prices for the year 1913 be taken as the base, the corresponding figure for June was 146.4, as compared with 157.2 for June, 1925.

According to the *Economist* index-number of wholesale prices, which records variations in the level at the end of each month, the effect of the General Strike upon commodity prices during May was less than might perhaps have been expected, the net change for that month being a decrease from 184.2 to 183.1, which was wholly accounted for by a further slump in jute prices, a matter quite unconnected with industrial conditions at home. During June, according to this record, changes in commodity prices were comparatively unimportant, but, although the increase was a small one,

from 183·1 to 183·4, it was the first month of 1926 in which a decline had not been registered, the net decrease in the six months amounting to 5·1 per cent. These changes brought the increase over the pre-war level, *i.e.* prices at the end of July, 1914, to 57·3 per cent.; the greatest increase of those making up this average figure was in food other than cereals and meat, prices of which were still 94 per cent. above the pre-war level, and the least increase was in the miscellaneous group, where the corresponding increase was only 38 per cent.

The *Statist* index-number showed a slight increase of 0·2 per cent. in wholesale prices during May, which was followed by a setback of hardly greater dimensions, *viz.* 0·6 per cent., in June. The result was to leave the total index-number at the end of June at 124·9, as compared with 125·7 a month before. The increase over the average for 1913 at the end of June was put by the *Statist* at 46·9 per cent.; with this may be compared the corresponding increase of wholesale prices in the United States, as measured by Bradstreet's index-number, *viz.* 38·3 per cent.

The average rise of retail food prices in Great Britain and Northern Ireland since July, 1914, which was put by the Ministry of Labour at 58 per cent. on May 1, remained at the same level a month later. Slight increases in the price of bacon, fish, flour, bread, sugar, and potatoes, were counterbalanced by decreases in the average prices of milk, butter, and cheese. On July 1 the increase had risen to 61 per cent. This increase was of a regular seasonal character, being due almost entirely to the substitution of the price of new potatoes for that of the old-crop potatoes at this time of the year. None of the other articles of food included showed any considerable movement in average price.

If rent, fuel, clothing, etc., be included with food, the average increase of retail prices on the pre-war standard of comfort, which stood at 67 per cent. on May 1, rose to 68 per cent. on June 1, and further to 70 per cent. a month later, as compared with 73 per cent. on July 1, 1925. The increase in the items other than food in these two months was largely due to the rise in the price of coal. From the fact that the food items accounted for 60 per cent. of the total family budget in July, 1914, it appears that on July 1 the average increase in the items other than food was over 83 per cent.

The following table summarizes for the chief countries the latest information as to retail prices overseas as reproduced in the *Labour Gazette*. The third column gives the percentage increase in retail food prices on those ruling in July, 1914, or some similar pre-war period: the fourth column gives the estimated increase for all the items covered by the budget in each case, such items, in addition to food, comprising generally rent, clothing, fuel and light, and other household requirements:—

Country.	Date of latest return.	Food.	All Items.
<i>Foreign Countries.</i>		Percentage increase.	Percentage increase.
Belgium	May, 1926	—	458
Denmark	January, 1926	77	94
Egypt (Cairo)	April, 1926	61	—
France (Paris)	June, 1926	444	385(2nd qr. 1926)
France (other towns) ...	May, 1926	423	—
Germany	May, 1926	42	40
Holland (Amsterdam)	December, 1925	45	77
Italy (Milan)	April, 1926	545	542
Norway	June 1926	95 (May)	118
Spain (Madrid)	May, 1926	83	—
Sweden	June, 1926	57	73 (April)
Switzerland	May, 1926	59	60
United States	May, 1926	58	78 (Dec., 1925)
<i>Overseas Dominions, etc.</i>			
Australia	May, 1926	63	56 (1st qr. 1926)
Canada	June, 1926	49	50
India (Bombay)*	June, 1926	52	55
Irish Free State	April, 1926	75	80
New Zealand	May, 1926	51	61
South Africa	May, 1926	19	32

* Native families.

Employment was seriously affected in the first half of May by the General Strike, and during the remainder of that month and the whole of June by the shortage of fuel and power in industry generally. In continuation of statistics relating to employment in Great Britain and Northern Ireland, quoted on p. 616 of the *May Journal*, returns from those trade unions which supplied figures at the end of May showed 13·2 per cent. of their members unemployed; this figure was exclusive of workpeople in the coal-mining industry who ceased work on account of the dispute. At the end of June the corresponding figure was 12·9 per cent., as compared with 12·3 per cent.

a year before. With these figures may be compared the percentage unemployed among the workpeople, numbering approximately 11,900,000, insured under the Unemployment Insurance Acts in Great Britain and Northern Ireland. Standing at 9·2 on April 26, it rose to 14·5 on May 24, and further to 14·7 on June 21. These figures included coal-mining, those miners who were not disqualified for benefit under the Acts by reason of the dispute being taken as unemployed for the purpose of the percentage, but not those who ceased work owing to the dispute. In industries other than coal-mining the percentage of unemployment on June 21 was 15·3, as compared with 15·1 on May 24. Some indication of the magnitude of the aggregate figures corresponding to these percentages is given in the returns published by the Ministry of Labour showing the total number of persons registered at Employment Exchanges in Great Britain and Northern Ireland as applicants for employment at various dates. On May 31 this figure was approximately 1,675,000 (exclusive of workpeople in the coal-mining industry who ceased work on account of the dispute), and by June 28 it had risen to 1,699,000. A comparison with the position of a year before is given in the following table. The returns relating to the iron and steel trades cover the whole month in each case :—

Week ending	Iron and steel trades. Percentage change on a year ago in aggregate number of men-shifts.	Other trades covered by the returns. Percentage change on a year ago.	
		Numbers employed.	Wages paid
May 22	— 60·9	— 4·6	— 8·4
June 26	— 62·0	— 5·5	— 10·6

In France the total number of unemployed persons remaining on the “live register” of the Exchanges on June 26 was only 7,916, as compared with 8,882 at the end of May and 10,185 at the end of June, 1925. Official statements as to employment in Germany, as summarized in the *Labour Gazette*, showed a continuation of the slight improvement in April; this improvement, as also a slight check to it in May, was largely of a seasonal character. The number of unemployed on the “live register” of Employment Exchanges fell from 2,520,394 at the end of March to 2,373,626 at the end of April, and a month later there was a further slight reduction to

2,347,688. Returns from German trade unions with a membership of over three and a-half millions indicated a percentage of unemployment falling from 21.4 at the end of March to 18.6 at the end of April, and further to 18.1 at the end of May, as compared with 3.6 at the end of May, 1925. In the case of Norway, the trade union percentage of unemployment at the end of March was 23.4, and a month later it had risen to 25, which compares with 9.5 a year before. For Swedish trade unions the *Labour Gazette* gives returns down to the end of May, when the percentage of unemployment was 9.7. According to returns quoted from the journal of the Dutch Statistical Office, as compiled by the State Department of Unemployment Insurance and Employment Exchanges, of the membership of subsidized unemployment funds, 5.3 per cent. were unemployed during the whole week ending May 29, and 1.9 per cent. for less than six days. For the previous month the corresponding percentages were respectively 5.2 and 1.7.

In Canada the index-number of employment, based upon returns received by the Dominion Bureau of Statistics from over 5,900 firms, employing 828,000 workers, rose from 91.4 on April 1 to 94.3 on May 1, and further to 101.0 on June 1, as compared with 94.5 on June 1, 1925. The monthly report on employment issued by the Federal Department of Labour Statistics at Washington is now based upon returns received from over 9,800 establishments in 54 industries, and covers approximately 3,000,000 workers. In April there was a decrease of 1 per cent. in the numbers employed, and in May a further decrease of 1.2 per cent. Aggregate wages paid showed decreases of 1.9 per cent. and 1.6 per cent. respectively in these two months. If the monthly average index-number of employment in manufacturing industries in 1923 be taken as 100, the corresponding index-number for April was 92.8, and that for May was 91.7, which compared with 90.9 for May, 1925.

Dr. H. Freudiger of Bern has written a monograph entitled *Das Soziale Existenzminimum* (62 pp., Burgdorf, 1926), which is virtually an attempt to determine the minimum cost of living of Swiss civil servants in the lowest rank of the service. His method is to ascertain by means of questionnaires the cost of board and lodging in various districts, to obtain estimates of the requirements in respect of clothing, medical treatment, education, etc., to ascertain

retail prices, and to control the results by reference to housekeeping books which have been obtained from some families. He reaches these conclusions: That the minimum for an unmarried male civil servant in a country district is 3,200 frs. per annum; in Bern, 3,462 frs. He estimates the minimum for unmarried women as about 10 per cent. less. For a family of 4, his estimate is 3,800 frs. in the country and 4,600 frs. in Bern. The corresponding figures for a family of 5 are 4,400 frs. and 5,200 frs. There is a certain element of conjecture in the calculations, and the precise extent of the statistical basis of fact is not very clearly displayed, but the brochure contains much interesting matter, and the distinction between an existence minimum and a social existence minimum is properly drawn. As Dr. Freudiger says, "The State, particularly in a modern democracy, expects its citizens to take part in votes and elections, to contribute to the bodily efficiency of youth, and to take an interest in such things." But the fulfilment of these duties involves expenditure beyond that required for mere keeping of body and soul together, which must be taken into account.

The text-volume of the Registrar-General's Statistical Review for 1924, which has just been published, includes an interesting study of mortality due to road motor vehicles, a subject recently brought to the notice of the Society. The age-distribution of deaths due to various types of vehicle (1911-24) shows, as was to be expected, a disproportionate number of young children among the victims, "but responsibility for this special risk is very unequally shared by the various types of vehicle. It is chiefly the free four-wheeled vehicle (car, lorry, or 'bus) which causes these deaths, tramcars causing few, and motor cycles, with their superior manœuvring capacity, very few indeed. The latter are, on the other hand, specially dangerous to their riders, over half the deaths due to them being at ages 20-45, at which less than a quarter of the total mortality occurs." A striking comparison between trams and 'buses in the Greater London area upon the basis of car-miles is made. In 1921-3, the estimated car-miles (in millions) of 'buses were 361 and of trams 273, the number of passengers carried being approximately equal, viz. rather more than 3,000 millions for each. Tramcars caused in that period 91, and motor 'buses 226 fatal accidents (reported to the police). "Probably the greater safety of the tram is largely due to its ample braking power, which may also account for its special superiority at ages 10-20, those at which boys fall off bicycles

in front of trams and 'buses. If so, it would appear that it is very largely to increase of braking power that we must look for decrease (relatively to mileage run) of the mortality under consideration. From this point of view, the recent tendency to fit four wheel brakes on motor cars is of much importance, and should in time effect a considerable reduction in the disproportionate mortality at 5—10, since at this age especially it may be possible to avert a fatal accident only by a full and timely use of ample braking power."

The Report for the year 1925 of the County Medical Officer of Health, London, records the lowest birth-rate (except during the war), and the lowest death-rate but one (in 1923) in the history of the county. A series of graphs of rates of mortality from 1841 to 1924 is provided. It is stated that the most remarkable of the curves is that showing the mortality from zymotic diseases. "It will be seen that at ages below 15 years the decrease in mortality from zymotic diseases, notwithstanding the practical disappearance of smallpox, cholera and typhus, has not kept pace in recent years with the decline in the mortality from all causes at these ages."

There is a discussion of the efficiency of various methods of forecasting epidemics of influenza, and it is suggested that the rule of balanced incidence about the thirty-fifth week of the year gives fairly accurate results. The application of the rule is illustrated in a table of actual and predicted prevalences from 1890 to 1926. The rule is a simple one. Thus in 1909 the week of maximum prevalence was in the twelfth of the year, which is $22\frac{1}{2}$ weeks short of the thirty-fifth. Assuming a centring on that week, the interval to the next maximum should be 45 weeks. Actually the next maximum was 46 weeks from the twelfth week of 1909, an error of only 1 week. Only twice (including the *annus mirabilis* of 1918) does the rule disagree with the fact to the extent of 10 or more weeks, and since 1920 the largest error has been 4 weeks. According to the rule, there should be a prevalence of influenza about the end of this year. Naturally the severity of the prevalence is not predicted and the rule is empirical.

Dr. Major Greenwood's Report on the Natural Duration of Cancer (No. 33 of the Ministry of Health's Reports on Public Health and Medical Subjects) presents a statistical analysis of 4,238 cases of cancer relating to seven primary sites. He then, taking as an

example the case of cancer of the breast, considers how to obtain an accurate numerical measure of the effects of treatment. He finds, on certain assumptions, that an untreated victim of cancer of the breast has 17.2 per cent. of the normal duration of life to expect *on the average*; that a woman operated upon under the most favourable conditions has 68.5 per cent., and one operated upon under the present unsatisfactory conditions (of delay in obtaining treatment) has 30.4 per cent. of the normal duration. The advantage secured by the woman operated upon under the most favourable conditions is, therefore, 51.3 per cent., and by the woman under average conditions 13.2 per cent. Applying his method to the annual quota of 5,000 new cases of cancer of the breast in England and Wales, of which not more than half undergo the radical operation, and of these fewer than half again are operated on under the most favourable conditions, he finds that out of the 5,000, 2,500 have 3.25 years of life apiece, 1,250 have 5.74 years apiece, and 1,250 have 12.93 years apiece—a grand total of 31,462.5 years. Had each enjoyed the normal expectation, the total would have been 94,350 years. “If all had been operated upon under the most favourable conditions, the quota of years would have been 64,650, more than 30,000 years of life beyond what they will actually have to look forward to. If we make the much more modest assumption, viz. that only the assumed quarter will be operated upon under the most favourable conditions, and the remainder under merely average conditions, we should still secure a bonus of more than 6,000 years of life.” The advantages to the individual concerned, and to the community, of sparing no effort to bring about presentation for treatment under the “best conditions,” i.e. at a stage when the growth is still strictly localized, does not involve the skin, and has not affected either axillary or supra-clavicular glands, is thus most authoritatively demonstrated. Dr. Greenwood’s Report should stimulate those concerned to do all in their power to secure the earliest possible surgical treatment in these cases.

Attention may be drawn to the publications of the Food Research Institute of Stanford University, California, founded in 1921 by the Carnegie Corporation of New York in conjunction with the Trustees of the University for the purpose of research in the production, distribution, and consumption of food. There are three directors attached to the Institute, assisted by a body of associates, research fellows and research assistants, and supervised by an

advisory committee, of which the President of the Carnegie Corporation, the President of Stanford University, the President of the United States Chamber of Commerce, and Mr. Hoover are among the best-known members. Much of the early work was of an organizing and investigatory character, and the first publication of the Institute was "Stale Bread Loss as a Problem of the Baking Industry." With December, 1924, began the issue of a series of "Wheat Studies," of which fifteen numbers have been published up to March, 1926. No. 1 led off with a review of the crop year, 1923-4; Nos. 3, 5, and 10 dealt with developments in the wheat situation, August to December, 1924, January to March, 1925, and April to July, 1925. No. 1 of the second volume dealt with the crop year 1924-5 and No. 2 reviewed the wheat situation, August to November, 1925. These numbers constitute an internal series, which appears likely to constitute one of the principal and most regular parts of the Institute's work; they are published with sufficient promptitude and are well documented.

A second series is represented by No. 2 (January, 1925), which gives a select list of current sources concerning wheat supplies, movements, and prices, and No. 9 (August, 1925), which under the title "The Disposition of American Wheat Supplies," gives a "critical appraisal" of the statistical procedures adopted by official and other authorities in the United States. Another critical number (No. 9, June, 1925) dealt with the estimates made by Broomhall and Sir James Wilson of European wheat requirements. More general economic problems are handled in No. 4 (March, 1925), which discusses whether or not a wheat surplus in the United States is "desirable or undesirable, dispensable or indispensable from the standpoint of national interest," and in No. 3 (January, 1926) of the second volume, which treats of the problems, opportunities, and limitations of "A National Wheat-growers' Co-operative." Perhaps the most serious statistical contributions of the Institute are to be found in "Average Pre-War and Post-War Farm Costs of Wheat Production in the North American Spring Wheat Belt" (No. 6, May, 1925), and in No. 8 (July, 1925), which deals with "Canada as a Producer and Exporter of Wheat." The latter is a most comprehensive review, and "Price Spreads and Shipment Costs in the Wheat Export Trade of Canada" (No. 5, March, 1926), completes it in certain respects. "Protein Content: a Neglected Factor in Wheat Grades" (No. 4, February, 1926), discusses the effects of the baker's demand for flour of a specified protein content on the producer, on

the miller, on the practice of hedging, and on world trade. It is thus in nature related to the first publication of the Institute, on "Stale Bread Loss as a Problem of the Baking Industry," which is now reckoned as the first of a "miscellaneous series," and has been followed by "The American Baking Industry, 1849-1923, as shown in the Census Reports" (Hazel Kyrk and J. S. Davis), and by "Combination in the American Bread Baking Industry" (by C. L. Alsberg). The latest number received (No. 8, July, 1926) discusses the decline in consumption of flour in the United States per head of the population, and the relation of this change to the consumption of other foods; while the preceding one (No. 7, June, 1926) gives a revision of the official estimates of wheat acreage and production in the United States since 1866, and, for the years before 1911, attempts to correct the acreage statistics of wheat on which the production estimates were based.

The Annual Railway Returns for Great Britain for the year 1925 have been issued by the Ministry of Transport a little earlier than the similar returns for recent years. They contain in a summary but clear form the principal financial and statistical results of our railways. The tables, which are introduced by a prefatory memorandum, are in four sections. The first section gives particulars, including an analysis of traffic receipts and the full statutory details of the expenditure accounts, for the railway companies in Great Britain as a whole, for the years 1913 and 1921 to 1925. A second section shows in comparative tables similar particulars for the years 1913, 1924 and 1925, for each of the four amalgamated railways. This arrangement is no doubt adopted for the convenience of the Railway Rates Tribunal, but the consolidated figures for the groups for the year 1913 afford an indispensable basis of comparison to all statisticians who wish to make any comparative study of the results of the great freight lines. The remaining sections of the tables show separately full financial and statistical particulars for each of the 86 companies which still retain a separate existence. These include the London electrified lines and a number of light railways, joint committees and non-working companies. Some of the statistical data, which are of considerable interest, are given for large subdivisions of the three groups carrying a heavy freight traffic.

Among the useful and interesting items of information to be extracted from these Returns are figures showing ton-miles of freight carried and passenger-miles. The average length of haul

for all freight traffic on all lines in 1925 was 53.95 miles. For passengers (including workmen and season-ticket holders) the records show an average journey of $10\frac{1}{2}$ miles in February and $14\frac{1}{2}$ miles in September, the two months for which these statistics are available, upon the amalgamated railways. The figures for all railways, including the suburban lines, are $9\frac{1}{2}$ and 13 miles. The number of passenger-miles per coaching train-mile varied from 69 to 89 in the two months, and the preface is careful to point out that this is not quite the same thing as the average load of passengers, since the mileage of vehicles carrying perishable and other merchandise by passenger train is included in the calculation. It is interesting to note that only half the total number of passengers was carried at full fares.

Operating results were not helped by the slump in coal and heavy traffics. But an average train-load of 130 tons and an average wagon-load of $5\frac{1}{2}$ tons (even for coal the average is only just over 9 tons) leave plenty of room for improvement. It would be absurd to make an absolute comparison with the figures attained on the United States railways, but the constant advance upon their already high figures is striking and raises the question whether our almost static results are not capable of improvement. An operating ratio of 83.26, as compared with 82.61 in 1924 and 63.53 in 1913, emphasizes the need for any economies in this or other directions that can possibly be achieved.

Information regarding the character of the goods carried is furnished by an analysis of the tonnage and receipts for the principal commodities conveyed by freight train under 72 headings, the tonnage so analysed representing 93 per cent. of the total freight traffic of the railways other than coal.

Apart from the interest of these Returns to those immediately involved, as railwaymen or traders, in questions of railway revenue and expenditure, they would, we think, repay study by statisticians and economists who are concerned to note changes in social habit and in the course of industrial development.

In conclusion we draw attention to the inclusion of information as to the electrical working of railways, to an analysis of traffic originating upon the canal systems, and to the fact that a detailed census of the staff is issued separately. In this mass of information we have searched for, but failed to find, the figure of the total salary and wages bill of the railway companies.

"The Facts of Industry: the case for publicity" is the title of a pamphlet embodying the report of an unofficial Committee of which Lord Astor was Chairman and the membership included representatives of industrial owners and Trades Unions and of economic and statistical science, among them Mr. W. L. Hichens, Mr. Frank Hodges, Mr. W. T. Layton, and Prof. Bowley. The Committee, starting with the assumption that it is "impossible to formulate a wise policy in industrial and economic affairs without knowing the facts of the case," set themselves to investigate the possibilities of securing greater publicity. They considered the question in relation to industrial peace, trade fluctuations, and the investing public. The chapter on Industrial Relations includes a survey of the information now normally available and particulars of cases in which statistics have been made available on special occasions; that on Industrial Fluctuations gives particulars of the statistical information relating to production and demand available in the United States. Definite recommendations with respect to the information needed are made under all three heads, and it is suggested "that the Board of Trade should be given statutory power to inaugurate a scheme of publicity on the lines suggested," and should itself collect and publish the information designed to assist the modification of trade fluctuations, and, "if it can find no other body to do the work," that required with a view to the betterment of industrial relations. Under the third heading, the question of the classes of information which should be divulged by a Joint Stock Company is considered in detail, and a list is given of the minimum requirements which in the Committee's opinion should be made compulsory.

For the last four years the United States Department of Commerce have published an annual estimate of the balance of its international payments. The fourth issue of this interesting series, for the year 1925, states that the exports of merchandise in that year were valued at 4,909 million dollars and the imports at 4,228 million dollars, giving a "favourable" balance of 681 million dollars, which is reduced to 666 million dollars after allowing for the values of parcel post and smuggled alcoholic liquors.

With regard to precious metals there was a net export of 168 million dollars in 1925 which, added to the merchandise balance, gives a favourable visible balance of 834 million dollars. "Current

invisible items," which include sums spent by American tourists abroad (660 million dollars), remittances of immigrants (310 million dollars), and ocean freight payments (103 million dollars), totalled 1,273 million dollars. Against these must be taken into account certain receipts such as interest on money owed by foreign governments, dividends on foreign investments, royalties on American films, etc., amounting to about 930 million dollars, and leaving an adverse balance of 343 million dollars. Taking the "favourable" balance on merchandise and the adverse balance on invisible items, the favourable balance is reduced to 323 million dollars, or, if gold and silver are included, to 491 million dollars.

Reference is also made to movements of capital, and it is estimated that Americans invested abroad, during 1925, 494 million dollars in excess of what foreigners invested in America, that American foreign investments now amount to about 10,400 million dollars, and that the country's total returns from foreign investments are greater now than ever before.

The possibility of errors is admitted in these calculations; the errors tend, however, to neutralize one another to some extent. The appendices include a comparison of the Board of Trade revised estimates of the trade balances of Great Britain with those of the United States.

The study of the variations in the economic situation in different countries is, fortunately, receiving progressively greater attention. The Harvard University Committee on Economic Research, whose work in this field in the United States has been supplemented by similar work under other auspices, has provided a stimulus to students elsewhere, and in London and Paris efforts to follow in the path opened up by this American work have resulted in systematic organizations with this end in view, while in Italy and elsewhere corresponding efforts to develop this particular field of enquiry are made. The recent addition to the groups of workers in this field of the Institut für Konjunkturforschung, under the direction of Hr. Wagemann of the Statistisches Reichsamt, secures an extension of the field of enquiry of very great importance. A survey of the data available, and of the general world situation at the end of 1925, published under the joint auspices of the Central Statistical Department and of the new "Institut," has prepared the way for the quarterly series of publications which the latter organization is

undertaking. The first issue shows how carefully and thoroughly the material has been collected and examined. The information regarding Germany and neighbouring States should prove a valuable supplement to the data hitherto available in this and other countries for throwing light on the nature and causes of the economic movements which are under investigation, and for determining how far indications of future tendencies can be secured.

The Italian Parliament has lately passed a law the effect of which is to reconstitute the Central Statistical Office on an entirely fresh basis, with increased powers and resources. The office, re-named the *Istituto Centrale di Statistica del Regno d'Italia*, has been created an independent Department of State directly under the Prime Minister, instead of, as usually in the past, being attached to an administrative department. Its functions are to include the compilation and publication of statistics for the use of the Government, and, especially, the preparation of the Statistical Year-book and a monthly Statistical Bulletin. The new Institute will be under the superintendence of a Council, the *Consiglio Superiore di Statistica*, consisting of a President and eleven officially nominated members, of whom five are to be university professors, three administrative officials, and three are to represent municipal statistical organizations. The duties of the Council will include that of ensuring the co-ordination of official statistics, whether or not these emanate from the central office, and assistance in the co-ordination of local with central statistical returns. We have received a copy of a Report by the *Ufficio Centrale* on the Bill for the reorganization of the statistical service, in which its provisions are explained and discussed, and suggestions are put forward for the modification of certain among them, at all events in practice. The document includes the text of the Bill, which passed into law, apparently without alteration, on July 9 and took effect the following day. Professor Gini was appointed President of the new Institute, and the addresses delivered by him and Signor G. Belluzzo, the Minister of National Economy, at the formal inauguration, which have since been published, make interesting reading. After comparing the statistical organizations of different countries, and briefly considering the advantages and disadvantages of centralization, the President discussed the methods by which the work of the Institute might most effectively be accomplished. He laid especial stress on the

necessity for separating the functions of collecting, tabulating, and publishing data, and of elaborating and utilizing them, and suggested the allocation of the latter work to a special "Ufficio studi," one branch of which (Servizio informazioni) would furnish information, as laid down by the Act, to public bodies, international organizations and other enquirers. Among other points, the President emphasized the need for a Census of Production and his desire to put the work in hand as early as possible.

Both the speakers at the inaugural ceremony dwelt on the melancholy condition of Italian Statistics in recent years, and the contrast with both their one-time eminence under Signor L. Bodio and the present position in other countries. It may be of interest to recall the vicissitudes endured by the Central Statistical Office since its organization in 1861 as an autonomous branch of the Ministry of Agriculture, Industry, and Commerce. After an existence of about eight and a-half years it was merged (1870) in the Ufficio dell' Economato Generale (a Department of Supplies), now called Direzione Generale della Statistica e dell' Economato. In 1872 these incompatibles were divorced, and the statistical office was again attached to the Ministry of Agriculture and, on the suppression of that department in 1877, to the Ministry of the Interior. In February, 1878, it was established as an independent Direzione Generale della Statistica, but a few months later returned to the reorganized Ministry of Agriculture, where it remained until, in 1911, it was amalgamated with the Office of Labour, the new title being Direzione Generale della Statistica e del Lavoro. In 1917 statistics again became the charge of a special department, now called Ufficio Centrale di Statistica, which, however, was reabsorbed in 1920 by the Ministry of Labour. In 1923 it emerged once more as a Direzione Generale, but was sent back almost immediately to the reconstituted Ministry of Industry, Commerce, and Labour, and thence to that of National Economy. It is to be hoped that after these buffetings the national statistical organization may find peace and the opportunity for successful development in its newly acquired independence, under the enthusiastic and competent guidance of its distinguished President.

A new economic publication, the *Kyoto University Economic Review*, reaches us as we go to press, and should interest readers

of this *Journal*. The first issue is printed in English, and subsequent issues are, we understand, to be printed in other European languages. The articles in this number appear to represent work done in the University by members of the staff of the Economic Department, and deal with a selection of important topics. Of statistical interest are "A Study in the Index Numbers of Prices of the Bank of Japan," and "Suicide Statistics in Japan classified according to Sex," while the Gold Paper Standard in Japan, Shipping Combinations, and Future Colonial Policy are among the other subjects treated. The journal bears witness to active work in the fields of economics and statistics.

OBITUARY.

THE HON. SIR TIMOTHY COGHLAN, K.C.M.G., 1857-1926
(Hon. Fellow, 1893-1905).

SIR TIMOTHY COGHLAN's lamented death deserves more than a passing note in the annals of the Royal Statistical Society, although he had ceased to be a Member of it during his later years of residence in this country. During the years 1886 to 1905 Sir Timothy held the office of Government Statistician to New South Wales, was later Statistical Adviser to the Commonwealth of Australia, and from 1905 to 1915, and again from 1920 to 1925, he acted as Agent-General for New South Wales and representative of Australia on the Pacific Cable Board. He established early in life his pre-eminence as an authority on statistics. He held numerous appointments in Australia involving statistical qualifications, such as those in connection with friendly societies, old-age pensions, inquiries connected with the distribution of the population for administrative and electoral purposes, and with the Censuses of 1891 and 1901. He was the author of several important publications—on the Wealth and Progress of New South Wales, on child-birth study, on the decline of the birth-rate in Australia and New Zealand; of the History of Labour and Industry in Australia; and of a Statistical Account of Australia and New Zealand. His distinction in these fields while in Australia was recognized by his election as an Honorary Fellow in 1893. For many years he was closely connected with the Society, and his opinion on statistical questions was more than once sought for by public authorities here. The present writer, for instance, remembers the importance attached to his views on direct taxation by the late Sir Charles Dilke as Chairman of the Select Committee on Income Tax in 1905, when he gave evidence in favour of the graduation and differentiation of the tax. He was always ready in those years to place his advice, drawn from an extensive experience of administration and statistics in Australia, at the service of those who sought it in this country.

B. M.

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July, 1926—Overproduction and underconsumption : a remedy : *Martin (P. W.)*. Some experiments in vocational psychophysiology : *Walther (Dr. Léon)*.

Metron, Vol. V, N. 3, I–XII, 1925—Über stochastische Asymptotem und Grenzwerte : *Slutsky (E.)*. Applications of "Student's" distribution : *Fisher (R. A.)*. New tables for testing the significance of observations : "Student." Expansion of "Student's" integral in powers of n^{-1} : *Fisher (R. A.)*. Capacità contributiva e gravame fiscale di alcuni Stati : *Boldrini (M.)*. The growth of human populations and the laws of their increase : *Knibbs (Sir G. H.)*.

LIST OF ADDITIONS TO THE LIBRARY.

Since the May, 1926, issue, the Society has received the publications enumerated below :—

I.—OFFICIAL PUBLICATIONS.

(a) United Kingdom and its several Divisions.

United Kingdom—

Overseas Trade, Department of. Reports on conditions in Bulgaria, March, 1926; Hungary, April, 1926; Italy, December, 1925; Netherlands, together with an annex on Dutch colonial trade, February, 1926; Portugal, with notes on the financial situation in Angola and Mozambique, March, 1926; Roumania, March, 1926. Industries and commerce of Spain, April, 1926. (The Department.)

England and Wales—

Agriculture and Fisheries, Ministry of. Report of the Commission on the Ouse Drainage District. 55 pp. London, 1926. Price 2s. net. Cmd. 2572. (Mr. Dodsworth.)

Health, Ministry of. Reports on Public Health and Medical Subjects :—
No. 33 : A report on the natural duration of cancer. By *Major Greenwood, F.R.C.P.* iv + 26 pp. London, 1926. Price 9d.

No. 34 : A report on the late results of operation for cancer of the breast (Leeds). v + 20 pp. London, 1926. Price 6d. net.

Industrial Fatigue Research Board :—

Report No. 35 : A physiological study of the ventilation and heating in certain factories. By *H. M. Vernon, M.D.*, and *T. Bedford*, assisted by *C. G. Warner*. iv + 84 pp. London, 1926. Price 3s. net.

Report No. 37 : Fan ventilation in a humid weaving shed. By *S. Wyatt*, assisted by *J. A. Fraser* and *F. G. L. Stock*. v + 33 pp. London, 1926. Price 1s. 9d. net. (The Board.)

Liverpool—

Liverpool corporation tramways. Report, 1926. 18 + 7 pp. Liverpool, 1926. (Mr. Dodsworth.)

(b) India and Dominions.

India—

District Gazetteers :—

Bengal. Faridpur. iii + 134 pp. Calcutta, 1925. Price 9s.

Coorg. Vol. B. 20 pp. Madras, 1926. Price 1 rupee 6 annas.

Punjab. Vol. VII. Part A. Ambala District, 1923-24, with maps. 145 pp. Lahore, 1925. Price 6s. 8d.

United Provinces of Agra and Oudh. Supplementary notes and statistics. Vols. XXXII, Basti District. Price 13 annas; XXXII, Gorakhpur District. R. 1; XXXIII, Azangarh District. R. 1; XXXIV, Naini Tal District. 14 annas; XLIV, Gonda District. 12 annas; XLVIII, Bara Banki District. 12 annas. 6 vols. Allahabad, 1925. Vol. B. Cawnpore District. Price Rs. 1.20; Etawah District. 7 annas; Fatehpur District. 10 annas. 2 parts. Allahabad, 1925. (High Commissioner for India.)

Bengal. Public Health Department. 11th Annual report of the Chief Engineer, 1923. 5 + iv pp., fol. Calcutta, 1924. Price Rs. 2. (Mr. Dodsworth.)

(b) **India and Dominions—Contd.****British Columbia—**

Annual Report of Minister of Mines, 1925. 466 pp. Victoria, 1926.
(Mr. Dodsworth.)

Ceylon—

Census Publications, 1921. Vol. IV. General tables. Maldive Islands.
386 pp., fol. Colombo, 1926. Price Rs. 7.50. (Mr. L. J. B. Turner.)

Report on the improvement of the office system in the Kachcheris of Ceylon.
93 pp. Colombo, 1925. (*Id.*)

Supplement (1925) to the handbook of commercial and general information
for Ceylon, 1922 viii + 90 pp. Colombo, 1926. Price R. 1.50. (*Id.*)

New Zealand—

Local authorities handbook, No. 1, 1926. x + 704 pp. Wellington, 1926.
Price 7s. 6d. (The Census Office.)

(c) **Foreign Countries.****Argentina—**

Buenos Aires (Province). Su estado social y económico presente y per-
spectivas para su future. 90 pp. La Plata, 1926. (Dirección General de
Estadística.)

Denmark—

Befolkning og Erhvervsforhold i Faerø Amt. 24 pp. København, 1926.
Price Kr. 0.50. (Statistiske Departement.)

Ejendomssalg, 1924. 57 pp. København, 1926. Price Kr. 0.75. (*Id.*)

Elektricitetsvaerker i Danmark, 1924/25. 92 pp. København, 1926. Price
Kr. 1.00. (*Id.*)

Privatfunktionaerernes Lønforhold m.v. 1923. 91 pp. København, 1926.
Price Kr. 1.00. (*Id.*)

Vurderingen til Ejendomskyld, pr. 1. Januar, 1924. 31 + 55 + 86 pp.
København, 1926. Price Kr. 4.00. (*Id.*)

Finland—

Élections des électeurs du Président de la République en 1925. 28 + 51 pp.
Helsingfors, 1926. (Bureau Central.)

Germany—

Die Gemeinden mit 2000 und mehr Einwohnern im Deutschen Reich nach
der Volkszählung vom 16. Juni, 1925. 79 pp. Berlin, 1926. (Statis-
tisches Reichsamt.)

Hungary—

Mouvement de la population de 1913 à 1918. xxiv + 70 + 136 pp. Buda-
pest, 1924. Price 60,000 couronnes-papier. (Nemzeti Museum, Buda-
pest.)

Recensement général de la population, 1910. Partie 6me. Résumé des
résultats. 1 vol. Budapest, 1924. Price 160,000 couronnes-papier.
(*Id.*)

Italy—

Censimento della popolazione del regno d'Italia, 1921. III. Venezia
Giulia. xxiv + 212 pp. Roma, 1926. Price L. 13.50. (Direzione
Generale.)

Netherlands East Indies—

Landbouwatlas van Java en Madoera. Deel I. Kaartenatlas. Deel II.
Tekst en tabellen. 2 vols. Price f. 10 each part. Weltevreden, 1926.
(Centraal Kantoor.)

(c) Foreign Countries—Contd.

Roumania—

Bucharest. Anuarul statistic, 1915-1923. 263 pp. București, 1924. Price Lei 200. (Direction Générale de Statistique.)

Russia—

Bulletin No. 85. March 15, 1924. (In Russian.) 111 pp. Moscow, 1926. (Central Statistical Office.)

Economical balance of the U.S.S.R., 1923-4. (In Russian.) vi + 273 + 2 + iv pp. Moscow, 1926. (*Id.*)

Bulletin, No. 119/120. March, 1926. Statistics of world economics. Parts 2-3. 188 pp. Moscow, 1926. (*Id.*)

Sweden—

Befolkningsrörelsen, 1918-20. viii + 76 + 176 pp. Stockholm, 1926. (K. Stat. Centralbyrån.)

Social and labour conditions in Sweden. Reprinted from Swedish Year-book, 1926. 29 pp. Price 25 öre. (K. Socialstyrelsen.)

Ukraine—

Statistical Bulletins :—

No. 78 : Movement of prices, 1924. (In Russian.) 83 pp. Kharkoff, 1925. (Direction Centrale.)

No. 79 : Taxation of earned incomes, 1924-25. (In Russian.) x + 43 pp. Kharkoff, 1926. (*Id.*)

No. 80 : Movement of population, 1924. (In Russian.) xvii + 39 pp. Kharkoff, 1926. (*Id.*)

No. 81 : Budget, 1923/24-1924/25. (In Russian.) vii + 39 pp. Kharkoff, 1926. (*Id.*)

United States—

Department of Agriculture—

Co-operative extension work, 1924 : with 10-year review. 131 pp. Washington, 1926. (The Department.)

Department Bulletins :—

No. 1377, March, 1926 : A study of the value of crop rotation in relation to soil productivity. By *W. W. Weir*. 68 pp. Washington, 1926. Price 15 cents. (*Id.*)

No. 1379, Jan., 1926 : Electroculture. By *L. J. Briggs* and others. 35 pp. Washington, 1926. Price 10 cents. (*Id.*)

No. 1382, Jan., 1926 : The relation between the ability to pay and the standard of living among farmers. By *E. L. Kirkpatrick* and *J. T. Sanders*. 32 pp. Washington, 1926. Price 5 cents. (*Id.*)

No. 1384, Feb., 1926 : The effectiveness of extension in reaching rural people. By *M. C. Wilson*. 20 pp. Washington, 1926. (*Id.*)

No. 1392, Jan., 1926 : Co-operative marketing of cotton. By *G. O. Gallin*. 48 pp. Washington, 1926. (*Id.*)

No. 1394, Jan., 1926 : Normal growth of range cattle. By *A. B. Clawson*. 12 pp. Washington. Price 5 cents. (*Id.*)

Miscellaneous circular No. 60 : Federal legislation providing for federal aid in highway construction, the construction of national forest roads and trails, etc. Rules and regulations. 30 pp. Washington, 1926. Price 5 cents. (*Id.*)

Separate from Year-book, 1924 :—

No. 911 : Exports and imports of agricultural products. Compiled by *G. B. L. Arner* and others. pp. 1041-1099. Washington, 1925. Price 10 cents. (*Id.*)

No. 915. Farm credit, farm insurance, and farm taxation. By *N. A. Olsen* and others. pp. 185-234. Washington, 1925. Price 15 cents. (*Id.*)

No. 918. Weather and agriculture. By *A. J. Henry* and others. pp. 457-558. Washington, 1925. Price 20 cents. (*Id.*)

Statistical Bulletin No. 12. Jan., 1926. Wheat and rye statistics, 1924. 119 pp. Washington, 1926. Price 15 cents. (*Id.*)

(c) Foreign Countries—*Contd.*United States—*Contd.**Bureau of Labor Statistics—*

Bulletins :—

No. 399: Labor relations in the lace and lace-curtain industries in the United States. By *G. L. Palmer*. iii + 78 + viii pp. Washington, 1926. Price 15 cents. (The Bureau.)

No. 401: Family allowances in foreign countries. By *M. T. Waggonman*. vi + 192 + ix pp. Washington, 1926. Price 30 cents. (*Id.*)

No. 404: Union scale of wages and hours of labor, May 15, 1925. iii + 212 + vii pp. Washington, 1926. Price 25 cents. (*Id.*)

Bureau of Mines—

Fatalities in the California petroleum industry during the year 1924. By *H. O. Miller*. 13 pp. March, 1926 (Mr. Dodsworth.)

Publications of the Bureau, July, 1925. 42 pp. Washington, 1925. (*Id.*)

Bureau of Standards—

Miscellaneous Publications, No. 66. Second Technical Conference of State Utility Commission Engineers, March 6-7, 1924. iv + 98 pp. Washington, 1925. Price 15 cents. (*Id.*)

New York State—

Special Bulletins :—

No. 142, March, 1926: Compensation awards year ended June 30, 1924. Compensated accidents, July, 1914-June, 1922. 189 pp. New York, 1926. (Department of Labor.)

No. 144, June, 1926: Some recent figures on accidents to women and minors. 70 pp. New York, 1926. (*Id.*)

No. 145, June, 1926: New York labor laws enacted in 1926. 59 pp. New York, 1926. (*Id.*)

(d) International.

League of Nations—

Financial Committee. Report on the work of the 22nd session of the Committee, June 3-9, 1926. 11 pp., fol. Geneva, 1926. (The League.)

Financial reconstruction of Austria: Report No. 41, by Commissioner-General. 13 pp., fol. Geneva, 1926; Termination of the functions of the Commissioner-General. 8 pp., fol. Geneva, 1926. (*Id.*)

Financial reconstruction of Hungary. Termination of the functions of the Commissioner-General. Resolution adopted by the Council of the League, June 10, 1926. 8 pp., fol. Geneva, 1926. (*Id.*)

Health Organisation. Report on the first results of laboratory work on malaria in England. By *S. P. James, M.D.*, assisted by *P. G. Shute*. 30 pp. Geneva, 1926. (*Id.*)

Loan for the settlement of Bulgarian refugees. Report of the Financial Committee and resolution. June 10, 1926. 20 pp., fol. Geneva, 1926. (*Id.*)

II.—AUTHORS AND MISCELLANEOUS.

Argetioianu (C.). Monetă și Valută. (Institutul Economic Românesc.) 18 pp. București: Cartea Românească S.A., 1924. (Institutul Economic Românesc.)

Association of Special Libraries and Information Bureaux. Report of proceedings at the Second Conference held at Balliol College, Oxford, Sept. 25-28, 1925. xv + 205 pp. London: The Association, 1926. Price 5s. (The Association.)

Bertolino (A.). Il problema della popolazione nel pensiero di G. Filangieri e le sue relazioni con le correnti intellettuali del sec. XVIII. Estratto dagli "Studi Senesi," 1926. Fasc. 2. 53 pp. Siena, 1926. (The Author.)

II.—Authors and Miscellaneous—Contd.

- Bonar (J.)*. The tables turned. A lecture and dialogue on Adam Smith and the classical economists. January, 1926. vi + 52 pp. London: P. S. King, 1926. Price 2s. net. (The Publishers.)
- Bourley (A. L.)*. Elements of statistics. 5th ed. xi + 462 pp. London: P. S. King, 1926. Price 18s. net. (The Publishers.)
- British Legion. Annual report and accounts, 1925. 103 pp. 1926. (The Legion.)
- Burns (E. M.)*. Wages and the State. ix + 443 pp. London: P. S. King, 1926. Price 16s. net. (The Publishers.)
- Cancer Review. A Journal of abstracts. Issued under the direction of the British Empire Cancer Campaign. Vol. 1, No. 1, 1926. 80 pp. Bristol: John Wright & Sons, etc., 1926. 2 copies. Price 3s. 6d. net. (The Review.)
- Carnegie Endowment for International Peace.—Division of International Law. Diplomatic correspondence of the United States concerning the independence of the Latin-American nations. By *W. R. Manning, Ph.D.* Vol. III. 1 vol. New York: Oxford University Press, 1925. (The Endowment.)
- Charlier (C. V. L.)*. The motion and the distribution of the stars. (Memoirs of the University of California, Vol. 7.) 127 pp. University of California Press, Berkeley, Cal., 1926. (The Author.)
- Cory (Isaac P.)*. A practical treatise on accounts. 184 + 65 pp. London: W. Pickering, 1840. (Mr. Waterlow King.)
- De Montmorency (H.)*. From Kant to Einstein. 39 pp. Cambridge: Heffer, 1926. Price 2s. 6d. net. (The Author.)
- Deutscher-Verein für Versicherungs-Wissenschaft. Inhaltsverzeichnis, 1900–1925. 91 pp. Berlin: Mittler & Sohn, 1926. (Deutscher Verein für V.W.)
- Dunn (Robert W.)*. American foreign investments. xi + 421 pp. London: G. Allen & Unwin; New York: Viking Press, 1926. Price 21s. net. (The Publishers in London.)
- Engineers, Society of (Inc.). Notes on preparing a tender. By *R. I. Money*. Reprinted from the Transactions of the Society of Engineers (Inc.). 48 pp. 1925. Price 3s. (Mr. Dodsworth.)
- Facts of Industry. The case for publicity. 62 pp. London: Macmillan, 1926. Price 1s. net. (The Publishers.)
- Fisher (Irving)*. Unstable money and the farmer. Address to Illinois Farmers' Institute, February 24, 1926. 15 pp. Springfield, Ill., 1926. (The Author.)
- A statistical relation between unemployment and price changes. Reprinted from the International Labour Review, June, 1926. 10 pp. Geneva, 1926. (*Id.*)
- Must we turn to free trade to assure continued prosperity? Reprinted from The Magazine of Wall Street, July 17, 1926. 4 pp. 1926. (*Id.*)
- Fisher (R. A.)*. A mathematical examination of the methods of determining the accuracy of an observation by the mean error, and by the mean square error. Reprinted from the Monthly Notices of the Royal Astronomical Society, vol. lxxx, No. 8, June, 1920. pp. 758–770. (The Author.)
- Frisch (Ragnar)*. Sur les semi-invariants et moments employés dans l'étude des distributions statistiques. Skrifter utgitt av Det Norske Videnskaps-Akademi i Oslo II. Hist.-Filos. Klasse, 1926, No. 3. 87 pp. Oslo, 1926. (The Author.)
- Goodenough (F. C.)*. International finance. An address delivered at New College, Oxford, to the Thomas More Society, Oxford, May 31, 1926. 9 pp. London: Blades, East and Blades, 1926. (The Author.)
- Gumbel (E. J.)*. Über ein Verteilungsgesetz. Extract from Zeitschrift für Physik. 12 pp. Berlin, 1926. (The Author.)
- Hargreaves (E. L.)*, Ph.D. Restoring currency standards. With a preface by Edwin Cannan, M.A., LL.D. ix + 106 pp. London: P. S. King, 1926. Price 6s. net. (The Publishers.)
- Hartley (E. L.)*. Return to the gold standard. Record of proceedings on resolution moved by E. L. Hartley at annual general meeting of the Association of British Chambers of Commerce, April 22, 1926. 8 pp. 1926. (The Author.)

II.—Authors and Miscellaneous—*Contd.*

Institut für Konjunkturforschung—

Vierteljahrshefte zur Konjunkturforschung. 1. Jahrgang 1926 Ergänzungsheft 1. Price 32 R.M. Heft 1. 90 pp. Price 5 R.M. 2 parts. Berlin, 1926. (Institut.)

Institutul Economic Romanesc. Buletinul, Maili, 1926. pp. 285–343. București: Sediul Institutului, 1926. (Institutul.)

International Institute of Agriculture. The cotton growing countries present and potential: production, trade, consumption. xxxvi + 316 pp. London: P. S. King, 1926. Price 12s. 6d. (The Publishers.)

Johns Hopkins University. Studies in Historical and Political Science, Series XLIV. No. 3. The wage policies of labor organizations in a period of industrial depression. By V. J. Wyckoff, Ph.D. 119 + xii pp. Baltimore: Johns Hopkins Press, 1926. (The University.)

Keynes (J. M.). The end of laissez-faire. 54 pp. London: Hogarth Press, 1926. Price 2s. (The Publishers.)

King (Benjamin T.). Patents for inventions. Trade marks. Two leaflets, 1926. (The Author.)

Konjunktturnyi Institut Supplement to the Monthly Economic Bulletin, Vol. II. Issue 1. Economic problems. (In Russian.) 216 pp. Moscow, 1926. (The Institute.)

London and Cambridge Economic Service. Special memoranda. No. 18. The British motor industry. By G. C. Allen. June, 1926. 26 pp. London, 1926; No. 19. July, 1926. International comparison of price changes. By A. L. Bowley. 15 pp. London, 1926; No. 20. July, 1926. The French iron and steel industry. By R. Jordan. 10 pp. London, 1926. (The Service.)

Manchester Guardian Commercial. July 22nd, 1926. British Columbia. 36 pp. 1926. (The Guardian Commercial.)

— International banking half-yearly review. July 29, 1926. 36 pp. 1926. (The "Manchester Guardian.")

Marston (Sir C.). Why? Articles reproduced from the "Daily Mail." 15 pp. Wolverhampton, 1925. Price 6d. (Mr. Dodsworth.)

Miner (John R.). The influence of winter climate on pulmonary tuberculosis in the United States. Reprinted from the American Review of Tuberculosis, April, 1926. pp. 366–372. 1926. (Prof. R. Pearl.)

National Council for Inland Waterways. Canals and inland waterways. 64 pp. Birmingham, 1926. (Mr. Dodsworth.)

Official Publications. A number of Belgian, Italian, Portuguese, and Spanish publications dealing with population, pathology, public health, etc. (Major P. Granville Edge.)

Peake (E. G.). An academic study of some money market and other statistics. xi + 105 pp. London: P. S. King, 1926. Price 15s. net. (The Publishers.)

Pearl (Raymond). A synthetic food medium for the cultivation of drosophila. Preliminary note. Reprinted from the Journal of General Physiology, March 20, 1926. pp. 513–519. 1926. (The Author.)

— The constitutional elements in the etiology of pneumonia. Reprinted from the Proceedings of the Society for Experimental Biology and Medicine, 1926. xxiii. pp. 573–675. 1926. (*Id.*)

— Vital statistics of the National Academy of Sciences. V. The growth of the Academy. Reprinted from the Proceedings of the National Academy of Sciences, April, 1926. pp. 258–261. 1926. (*Id.*)

— and Bacon (A. L.). Biometrical studies in pathology. IV. Statistical characteristics of a population composed of necropsied persons. Reprinted from the Archives of Pathology and Laboratory Medicine, March, 1926. Vol. I. pp. 329–347. Chicago, 1926. (Prof. R. Pearl.)

Recess Studies. Edited by Sir Alexander Grant, Bt., LL.D. 409 + 20 pp. Edinburgh: Edmonston and Douglas, 1870. (Purchased.)

II.—Authors and Miscellaneous—Contd.

- Rogowski (Dr. E.)*. Das Deutsche Volkseinkommen. Volkswirtschaftliche Studien, Heft 13. viii + 157 pp. Berlin: Emil Ebering, 1926. (The Publishers.)
- Russian Economic Bulletin. VI, 1926. 267 pp. Prague, 1926. (Prof. Procopovicz.)
- Special number. Memoir of Prof. A. A. Chuprov. 32 pp. Prague, 1926. (*Id.*)
- Scott (Sir Leslie), K.C., M.P.* Shipping and international law. Reprinted from Brassey's Naval and Shipping Annual, 1924. 24 pp. (Mr. Dodsworth.)
- Shipbuilding Employers' Federation and Shipyard Trade Unions. Report of joint inquiry into foreign competition and conditions in the shipbuilding industry. Two copies. 53 pp. June, 1926. (The Joint Committee.)
- Shrapnell-Smith (E. S.)*. The future of road motor transport. Excerpts from an address, Jan. 7, 1926. 16 pp. 1926. (Mr. Dodsworth.)
- Stamp (Sir J.)*. The Christian ethic as an economic factor. (The Social Service Lecture, 1926.) 106 pp. London: Epworth Press, 1926. Price 2s. net. (The Author.)
- Teare (Herbert E.)*. Australian banking currency and exchange. xx + 316 pp. Sydney: Alexander Hamilton Institute of Australia, 1926. Price 10s. 6d. (The Author.)
- A digest of Australian and New Zealand banking and currency legislation. Supplemental to the author's "Australian banking, currency and exchange." 96 pp. Sydney: Alexander Hamilton Institute of Australia, 1926. (*Id.*)
- "Times" Trade and Engineering Supplement. International Banking Section, June 19, 1926. 48 pp. London, 1926. Price 3d. ("The Times.")
- University of Illinois. Bulletin XXIII. June 29, 1926. No. 43. The current ratio in public utility companies. 28 pp. Published by the University, Urbana, 1926. (The University.)
- University of Liverpool. Faculty of Arts. Liverpool School of Social Sciences and Administration. Prospectus of courses, session 1926-7. 87 pp. Liverpool: Tinling, 1926. (The University.)
- University of Pennsylvania. Federal regulation of railroad security issues. By *Julius Grodinsky*. A thesis. 71 pp. Philadelphia, 1926. Two copies. (The University.)
- The definition of income and its application in federal taxation. By *William Wallace Hewett*. A thesis. v + 91 pp. Two copies. Philadelphia, 1925. (*Id.*)
- Wainstein (Albert)*. Récolte, cycles météorologiques et économiques, le problème de la prévision économique. Extrait du recueil des ouvrages de l'Institut de l'Economie agricole sous le titre "Les problèmes de la récolte." 60 pp. Moscow, 1926. (The Author.)
- Weinberger (Otto)*. Francis Ysidro Edgeworth. Ein Nachruf. Abdruck aus Jahrbücher für Nationalökonomie und Statistik, 124. Band III. Folke 69. Band. pp. 205-217. Jena: G. Fischer, 1926. (The Author.)
- Die Grenznutzenschule. xvi + 123 pp. Halberstadt: H. Meyer's Buchdruckerei, 1926. (*Id.*)
- Wilson (Thomas)*. A discourse upon usury. Edited, with an historical introduction. By *R. H. Towney*. viii + 392 pp. London: G. Bell, 1925. Price 15s. net. (The Publishers.)
- Wyckoff (J.), Ph.D., and Lingg (C.)*. Etiology in organic heart disease with an introduction by *Alfred E. Cohn, M.D.* Reprinted from the American Heart Journal, April, 1926. 30 pp. 1926. (New York Tuberculosis and Health Association.)
- Yves-Guyot*. Prévisions relatives aux paiements en nature des réparations et des dettes interalliées. Communication faite à la Société de Statistique de Paris, 17 Mars, 1926. 15 pp. Nancy-Paris-Strasbourg: Berger-Levrault, 1926. (The Author.)
- Agence économique et financière. Supplément, 18 Juin, 1926. Cinquantenaire de M. Yves-Guyot à la Société de Statistique. Discours de M. P. Diaz. 1 sheet. (*Id.*)

ANNUAL LIST OF ADDITIONS TO THE LIBRARY.

Since the end of July, 1925, the Society has received by presentation or purchase the periodical (official and other) publications enumerated below.

(a) United Kingdom and its several Divisions.

United Kingdom—

Board of Trade Journal, 1925-26. Customs and Excise, 16th Report, 1925. Factories and Workshops, Annual Report of Chief Inspector. Friendly Societies, Reports for 1923-24. Health of the Army, Reports for 1923 and for 1924. Industrial Fatigue Research Board, Annual Report. Inland Revenue, 68th Report of Commissioners, 1925. Labour Gazette, 1925-26. Mines Department, Annual Reports. Mines Department, List of Quarries. Mines, List of, for 1924. Mines, Fatal Accidents, 1925 (Preliminary Statement). Mint Report. Navigation and Shipping in 1924. Public Works Loan Board, Report, 1924-25. Railway Returns of Great Britain. Safety in Mines, Research Board, Report. Shipping Casualties and Deaths on Vessels, 1923 and 1924. Statistical Abstract of U.K., 1910-24; 69th Number. Statistical Abstract for British Oversea Dominions. Trade, Annual Statement for 1924, Vols. 1-4; also the Monthly Trade Returns, 1925-26. Trade and Commerce of Foreign Countries and British Possessions (current issues). War Office Library, Subject Index, Annual Supplement, 1925. Crown Lands, Report of Commissioners, 1925.

England and Wales—

Births, Deaths and Marriages; Statistical Review, 1924, Tables, Part 1, Medical, Part 2, Civil, and Text; also Quarterly and Weekly Returns, 1925-26.

Agricultural Statistics, 1925 (in parts). Agricultural Market Report (weekly), 1925-26. Journal of Ministry of Agriculture (monthly), 1925-26. Ecclesiastical Commissioners, Report, 1925. Health Ministry, Annual Report. Health Ministry, Annual Report of Chief Medical Officer. Judicial Statistics, England and Wales: Civil for 1924, Criminal for 1924. Poor Law Relief Returns (current issues).

London County Council. Annual Report of the Council, 1924, Vols. 1-5. London Statistics, Vol. 29, 1923-24, and the Gazette, 1925-26. Statistical Abstract for London, 1915-24, Vol. 19.

Metropolitan Asylums Board. Annual Report, 1924-25, 1925-6.

Metropolitan Water Board. Accounts and Report, 1924-25.

Municipal Accounts of Acton, Battersea, Birmingham, Carlisle, Hammsmith, Hull, Ipswich, Islington, Leicester, Liverpool, Mersey Docks and Harbour Board, Manchester, Nottingham, Ossett, Southgate, Tunbridge Wells, for 1924-25.

Reports of Medical Officers of Health of Birkenhead, Birmingham, Derby, Liverpool, Manchester, Paddington, Poplar, Preston, Wigan, Wolverhampton, for 1924-25.

Calendars, 1925-26, of the Universities of Durham, Leeds, Liverpool, London, Birkbeck College, University College, Manchester, Sheffield, University Colleges of Wales and South Wales, and City of London College.

(a) United Kingdom and its several Divisions—*Contd.***Scotland—**

Reports and Returns dealing with Agriculture, Births, Deaths, Marriages, Education, Lunacy, &c., 1924-25.

Municipal Accounts of Edinburgh, 1925.

Reports of Medical Officers of Health for Edinburgh, Aberdeen and Glasgow, 1924-25.

Calendars of the Universities of Edinburgh, Aberdeen and Glasgow.

Northern Ireland—

Births, Deaths, Marriages, Annual Report, 1924, and Quarterly Returns (current issues). Local Taxation Returns, 1922-23.

Belfast. Queen's University Calendar, 1925-26.

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